## 4.2 LOS ALAMOS SITE

This section discusses the affected environment at the Los Alamos National Laboratory (LANL) for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

### 4.2.1 Land Use and Visual Resources

#### 4.2.1.1 Land Use

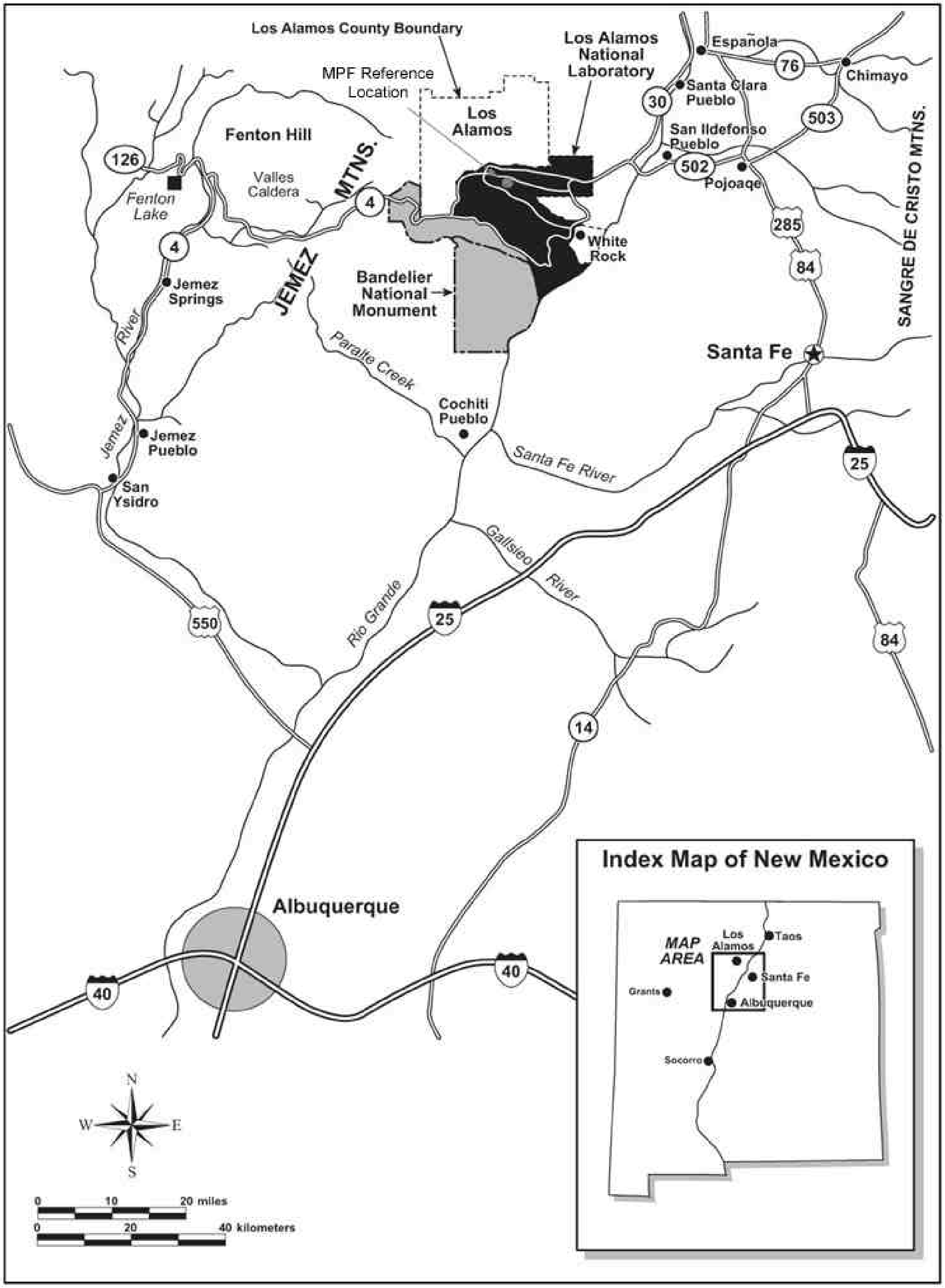
LANL, comprised of 10,400 hectares (ha) (25,600 acres [ac]), is located in north-central New Mexico, 96 kilometers (km) (60 miles [mi]) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe Counties (see Figure 4.2.1.1–1). LANL is owned by the Federal Government and administered by DOE's National Nuclear Security Administration (NNSA). It is operated by the University of California under contract to DOE.

LANL and the surrounding region are characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east. The Santa Fe National Forest, which includes the Dome Wilderness Area, lies to the north, west, and south of LANL (see Figure 4.2.1.1–2).

The American Indian Pueblo of San Ildefonso and the Rio Grande River border the site on the east, and the Bandelier National Monument and Bandelier Wilderness Area lie directly south. Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation (e.g., skiing, fishing), agriculture, and the state and Federal governments for its economic base. Area communities are generally small and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes Native American communities. Lands of the Pueblo of San Ildefonso share LANL's eastern border, and a number of other pueblos are clustered nearby.

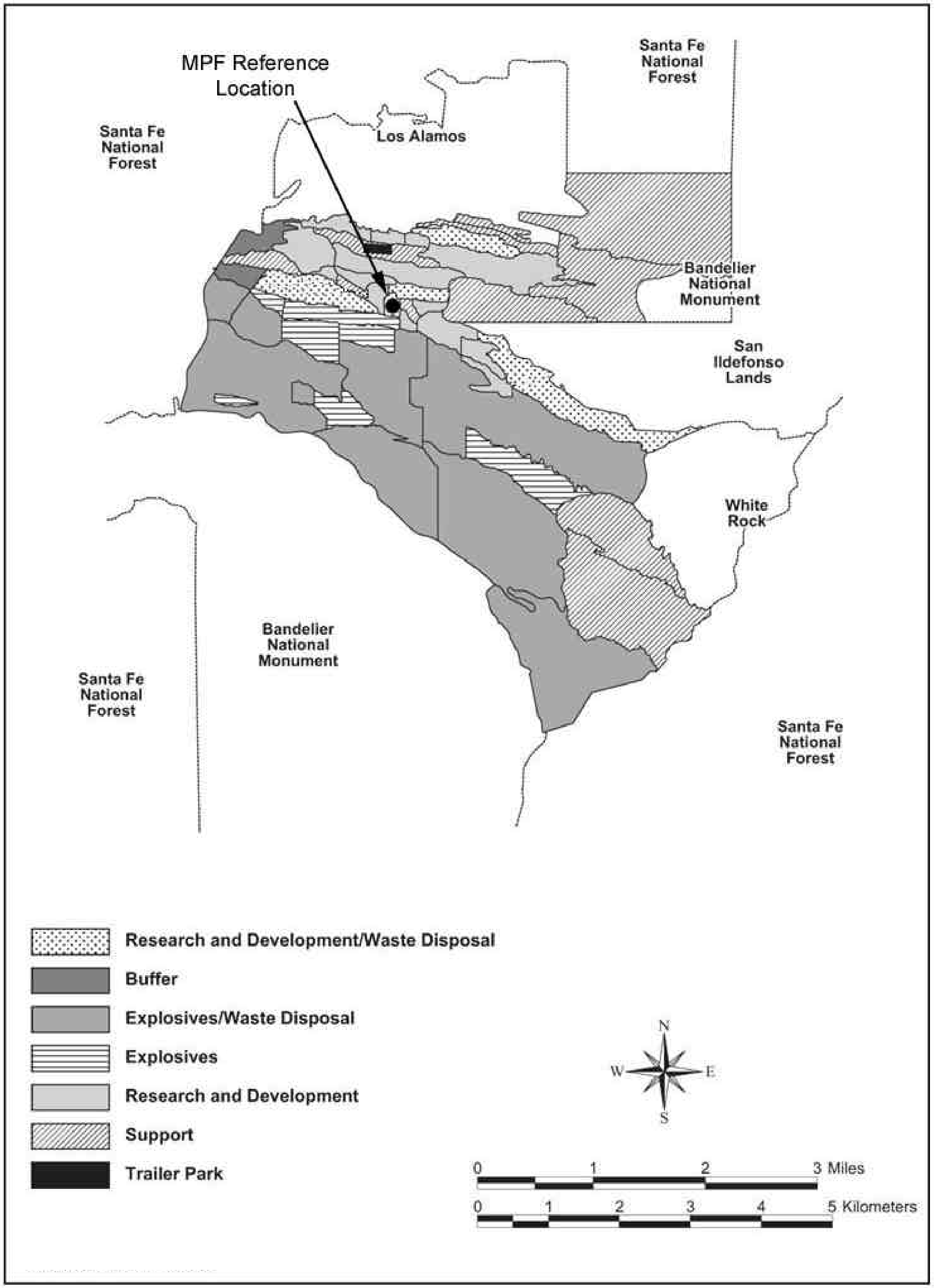
Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Santa Fe Counties include the county governments, DOE, the U.S. Forest Service, the National Park Service, the State of New Mexico, the U.S. Bureau of Land Management (BLM), and several Native American pueblos. Bandelier National Monument and Santa Fe National Forest border LANL primarily to the southwest and northwest, respectively; however, small portions of each also border the site to the northeast (see Figure 4.2.1.1–2).

LANL is divided into technical areas (TAs) that are used for building sites, experimental areas, and waste disposal locations (see Figure 4.2.1.1–3). However, those uses account for only a small part of the total land area of the site. Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL




Source: DOE 2002k.

**Figure 4.2.1.1–1. Location of Los Alamos National Laboratory**




Source: DOE 2002k.

**Figure 4.2.1.1–2. Land Use at Los Alamos National Laboratory**

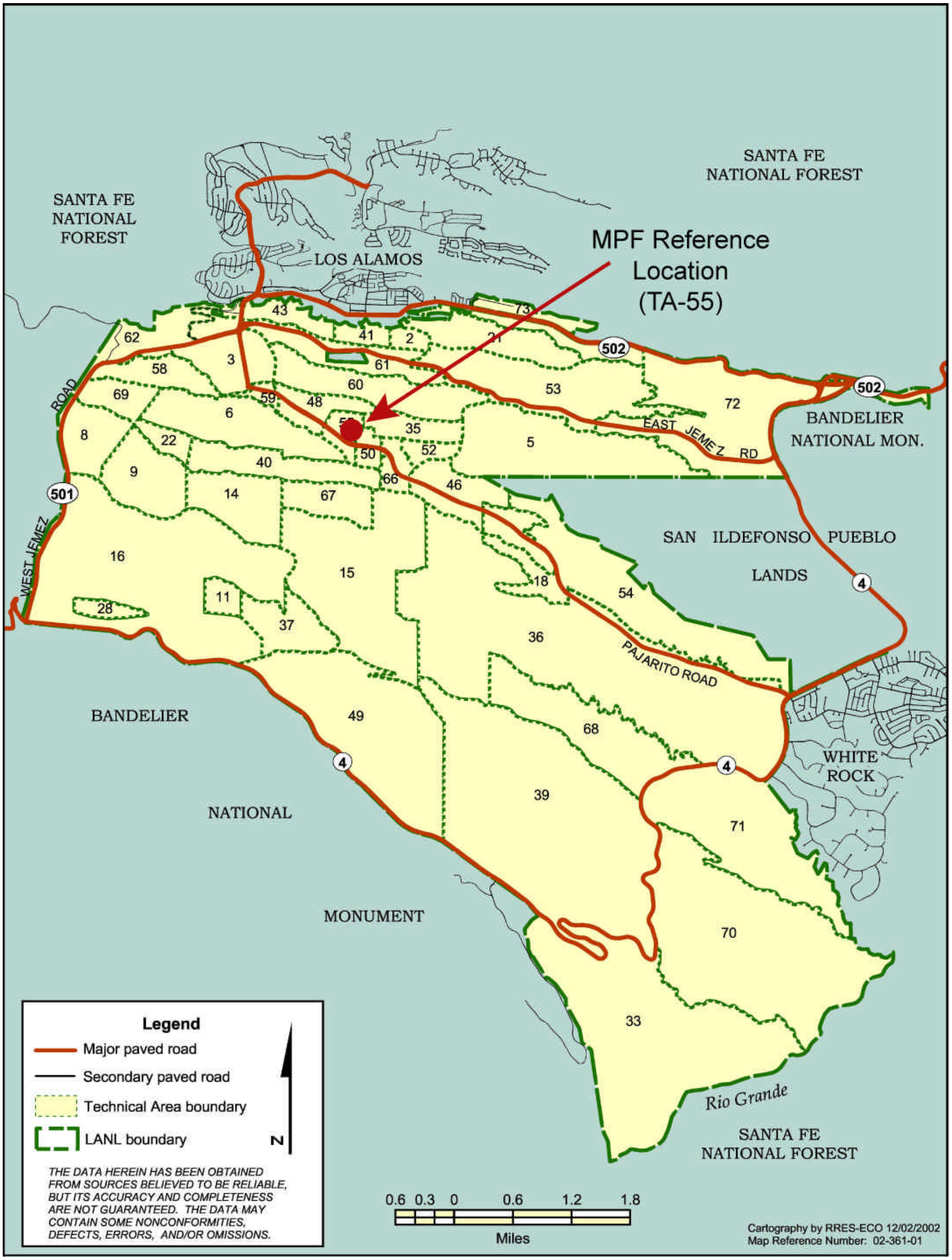



**Figure 4.2.1.1–3. Los Alamos Site**

as a National Environmental Research Park, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on pinyon-juniper woodland ecosystems (DOE 1996e). In 1999, the White Rock Canyon Wildlife Reserve was dedicated. It is about 405 ha (1,000 ac) in size and is located on the southeast perimeter of LANL. The reserve is managed jointly by DOE and the National Park Service (LANL 2000c).

Land use characterization at LANL is based on the most hazardous activities in each TA and may be organized into six categories: Support, Research and Development (R&D), Waste Disposal, Explosives, Explosives/Waste Disposal, and Buffer (see Figure 4.2.1.1–2). Any actual future consideration of changing land use within a particular LANL land use category location would be guided by LANL's 10-Year Comprehensive Site Plan (LANL 2002d).

TA-55, the reference location for the MPF, is located within the R&D land use category (see Figures 4.2.1.1–2 and 4.2.1.1–3). Facilities at TA-55 are located on a 16-ha (40-ac) site that is situated 1.8 km (1.1 mi) south of the city of Los Alamos. Forty-seven percent of the site has been developed. The main complex has five connected buildings; the Nuclear Materials Storage Facility is separate from the main complex but shares an underground transfer tunnel.

Section 632 of the "Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, FY1998," (Public Law 105-119) directs the Secretary of Energy to convey parcels of land that are identified by DOE as being suitable for conveyance or transfer. These parcels would be those that are not now required to meet the national security mission of DOE or would not be required for that purpose before the end of the next 10-year period. Ten parcels of land totaling approximately 1,619 ha (4,000 ac) are no longer considered necessary to LANL's mission and have been identified for transfer. The land is to be transferred to Los Alamos County or the San Ildefonso Pueblo for community self-sufficiency, economic diversification or historical, cultural, or environmental preservation. As mandated remediation efforts are completed, the land parcels are transferred. The first transfer, approximately 13.4 square kilometers ($km^{2)}$ (5.2 square miles [$mi^2$]), occurred on October 1, 2002.

In May 2000, a wildfire known as the Cerro Grande Fire, burned approximately 17,462 ha (43,150 ac), of which 3,110 ha (7,684 ac) were within the boundaries of LANL. Within LANL, 45 structures (trailers, transportables, and storage units) were totally destroyed and 67 were damaged. The fire also affected land use in the Los Alamos townsite, where about 230 housing units were totally destroyed (LANL 2000a, DOE 2000f).

The Los Alamos County Comprehensive Plan, which establishes land-planning issues and objectives, addresses private and county lands comprising 3,488 ha (8,613 ac). Twenty-nine percent of this land is located within the Los Alamos townsite and 26 percent is located in the community of White Rock. The remaining 45 percent of the land is undeveloped and is used for recreational activities and open space. LANL is autonomous from a planning perspective and, therefore, is not addressed in the county plan. Land use designations in the Santa Fe County Plan are based on groundwater protection goals. Therefore, this plan designates LANL as "Agricultural and Residential," although, as noted above, there are no agricultural activities on site, nor are there any residential uses within LANL boundaries (DOE 1996e).

### 4.2.1.2 Visual Resources

The topography in northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. Undeveloped lands within LANL have a U.S. Department of Interior BLM Visual Resource Management rating of Class II and III. Table 4.2.1.2–1 below lists and defines the rating system. Management activities within these classes may be seen but should not dominate the viewshed (the topographically bounded area that may be viewed from this location).

**Table 4.2.1.2–1. Bureau of Land Management Visual Resource Management Classification Objectives**

| Classification | Objective |
|---|---|
| **Class I** | To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention. |
| **Class II** | To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. |
| **Class III** | To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. |
| **Class IV** | To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. |

Source: DOI 2001.

Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire. Although the visual environment is still diverse and panoramic, portions of the visual landscape since the Cerro Grande Fire are dramatically stark. Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Local effects include reduced visual appeal of trails and recreation areas (DOE 2000f).

The majority of TAs are located on mesas. At lower elevations, at a distance of several miles away from LANL, the facility is primarily distinguishable in the daytime by views of its water storage towers, emission stacks, and occasional glimpses of older buildings that are very austere and industrial in appearance. At elevations above LANL, along the upper reaches of the Pajarito Plateau rim, the view of LANL is primarily of scattered austere buildings and the nested multi-story buildings of TA-3. Developed areas within LANL are consistent with a Class IV Visual Resource Management rating, in which a major modification of previous natural landscape dominates the view and is the focus of viewer attention. At night, the lights of LANL are directly visible from various locations across the viewshed as far away as the towns of Española and Santa Fe.

TA-55 is located on a mesa about 1.6 km (1 mi) southeast of TA-3. While not visible from lower elevations, TA-55 is visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim. It appears as one of several scattered built-up areas among the heavily forested areas of the site. Developed portions of TA-55 would have a Class IV Visual Resource Management rating.

### 4.2.2 Site Infrastructure

An extensive network of existing infrastructure provides services to LANL activities and facilities as shown in Table 4.2.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for LANL. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

**Table 4.2.2–1. LANL Site-wide Infrastructure Characteristics**

| Resource | Current Usage | Site Capacity |
|---|---|---|
| **Transportation** | | |
| Roads (km) | 130[a] | NA |
| Railroads (km) | 0 | NA |
| **Electricity**[b] | | |
| Energy consumption (MWh/yr) | 491,186 | 963,600 |
| Peak load (MWe) | 83 | 107 |
| **Fuel** | | |
| Natural gas ($m^3$/yr) | 70,000,000[c] | 229,400,000[d] |
| Liquid fuels (L/yr) | Negligible | Not limited |
| Coal (t/yr) | 0 | NA |

NA = not applicable.
[a] Includes paved roads and paved parking lots only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Usage value for LANL plus baseline usage for other Los Alamos County users.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
Source: DOE 2002k.

#### 4.2.2.1 Transportation

Two state roads provide access to LANL. New Mexico State Highway (NM) 501 (West Jemez Road) enters the region from the south and NM 502 enters from the east. The roads used to access the site have some sharp curves due to the location of LANL on a mesa approximately 213-305 m (700-1,000 ft) above the canyon floor. NM 502 is a two- to five-lane highway that winds steeply as it rises from the canyon floor. Other roads into the LANL area, NM 501, East Jemez Road, and Pajarito Road are all two-lane roads. There are approximately 130 km (80 mi) of paved roads and paved parking areas at LANL. The site has no rail service and the nearest commercial rail system is in Lamy, New Mexico, 83 km (52 mi) south of LANL (DOE 1999g). Los Alamos has a small airport which is located parallel to East Road at the southern edge of the Los Alamos community. The airport is owned by the Federal Government but is operated and maintained by Los Alamos County. The airport provides limited commercial services through specialized contract carriers (DOE 1999a). Larger commercial airports are located in Albuquerque and Santa Fe.

#### 4.2.2.2 Electrical Power

Electricity is supplied to LANL via two regional 115-kilovolt (kV) transmission lines, the Norton-Los Alamos Line and the Reeves Line, by the Los Alamos Power Pool, a group of hydroelectric, coal, and natural gas power generators located throughout the western United States (DOE 2002k). A gas-fired steam/power plant located in TA-3 also can generate additional power on an as-needed basis. DOE maintains various low-voltage transformers at LANL facilities and approximately 55 km (34 mi) of 13.8-kV distribution lines (DOE 2000b, DOE 2002k).

Contractually, LANL receives 73 megawatts (MW) of electricity during the winter months and approximately 95 MW during spring and early summer months from the Los Alamos Power Pool (LANL 2000b). Onsite electrical power generation capacity from the TA-3 gas-fired steam/power plant is approximately 12 MW in the summer and 15 MW during winter. The steam/power plant provides the additional electricity necessary to meet peak load demands exceeding the allowable supply. The TA-3 steam/power plant and much of the electrical distribution system at LANL have past or are nearing the end of their design life and require replacing or upgrading. Construction and operation of a new 115-kV power line is planned and would originate at the existing Norton Substation near White Rock and terminate at the proposed DOE-administered West Technical Area Substation (DOE 2000b, DOE 2002k).

Electricity consumption and peak demands have historically fluctuated due to the power demand of the Los Alamos Neutron Science Center. Site electrical capacity is 963,600 megawatt hour per year (MWh/yr), based on a summer peak load capacity of 110 megawatt electric (MWe) (DOE 1999g). Peak load usage was 83 MWe in fiscal year 2000 (DOE 2002k).

#### 4.2.2.3 Fuel

Natural gas is the primary fuel used by the Los Alamos townsite and at LANL. At LANL, natural gas is burned to produce steam to heat buildings and meet peak demands (LANL 2000b). The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. In August 1999, DOE sold a 209-km (130-mi) long main gas supply line and metering stations for the Los Alamos townsite and vicinity to the Public Service Company of New Mexico (LANL 2000b). Contractually, LANL receives 229 millioncubic meters ($m^3$) (8.07 billion cubic feet [$ft^3$]) of natural gas per year. In addition to natural gas, small quantities of oil are used as a backup fuel source (DOE 1999g, DOE 2002k).

### 4.2.3 Air Quality and Noise

#### 4.2.3.1 Climate and Meteorology

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 25 to 51 centimeters (cm) (10 to 20 inches [in]) per year. The climate of the Los Alamos townsite is not as arid (dry) as that part near the Rio Grande River, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau. Climatological averages for atmospheric variables such as temperature, pressure, winds, and precipitation presented are based on observations made at the official Los Alamos meteorological weather station from 1961-1990. Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of -8.1 degrees Celsius (°C) (17.4 degrees Fahrenheit [°F]) in January to a mean high of 27°C (80.6°F) in July. Normal (30-year mean) minimum and maximum temperatures for the community of White Rock, range from a mean low of -9.7ºC (14.6ºF) in January to a mean high of 29.8ºC (85.6ºF) in July. Temperatures in Los Alamos vary with altitude, averaging 3 °C (5°F) higher in and near the Rio Grande Valley, which is 1,981 m (6,500 ft) above sea level, and 3 to 5.5°C (5 to 10°F) lower in the Jemez Mountains, which are 2,600 to 3,050 m (8,500 to 10,000 ft) above sea level. Los Alamos townsite temperatures have dropped as low as -28°C (-18°F) and have reached as high as 35°C (95°F). The normal annual precipitation for Los Alamos is approximately 48 cm (19 in). Annual precipitation rates within the county decline toward the Rio Grande Valley, with the normal precipitation for White Rock at approximately 34 cm (14 in). The Jemez Mountains receive over 64 cm (25 in) of precipitation annually. The lowest recorded annual precipitation in the Los Alamos townsite was 17 cm (7 in) and the highest was 100 cm (39 in).

Thirty-six percent of the annual precipitation for Los Alamos County and LANL results from thundershowers that occur in July and August. Winter precipitation falls primarily as snow. Average annual snowfall is approximately 150 cm (59 in), but can vary considerably from year to year. Annual snowfall ranges from a minimum of 24 cm (9 in) to a maximum of 389 cm (153 in).

Los Alamos County winds average 3 meters per second (m/s) (7 mile per hour [mph]). Wind speeds vary throughout the year, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June), due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 34 m/s (77 mph). Surface winds often vary dramatically with the time of day, location, and elevation, due to Los Alamos' complex terrain.

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope airflow often develops over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau. Analyses of Los Alamos Canyon wind data indicate a difference between the atmospheric flow in the canyon and the atmospheric flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Wind conditions are discussed further in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL SWEIS) (DOE 1999a).

Thunderstorms are common in Los Alamos County, with an average of 60 thunderstorms occurring in a year. Lightning can be frequent and intense. The average number of lightning-caused fires in the 1,104 ha (2,727 ac) of Bandelier National Monument from 1990-1994 was 12 per year. There are no recorded instances of large-scale flooding in Los Alamos County. However, flash floods from heavy thunderstorms are possible in areas such as arroyos, canyons, and low-lying areas. No tornadoes are known to have touched the ground in the Los Alamos area.

### 4.2.3.2 Nonradiological Releases

LANL operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. LANL is located within the Upper Rio Grande Valley Intrastate Air Quality Control Region (AQCR). The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332).

In addition to the National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (EPA), the State of New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permitting requirements for new or modified sources of regulated air pollutants. Air quality permits have been obtained from the State Air Quality Bureau for beryllium operations, a rock crusher, an asphalt plant, a diesel generator, and power plant that were modified or constructed after August 31, 1972. In accordance with Title V of the *Clean Air Act*, as amended, and New Mexico Administrative Code 20.2.70.402, the University of California and DOE submitted a site-wide operating permit application to the New Mexico Environment Department (NMED) in December 1995. The NMED ruled this application complete but did not process it. LANL submitted an updated Title V application in November 2002, which replaced the 1995 application. NMED ruled this application complete in December 2002 and is currently processing it.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. Table 4.2.3.2–1 presents information regarding the primary existing sources. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a R&D facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit air pollutants.

**Table 4.2.3.2–1. Air Pollutant Emissions at LANL in 2001**

| Pollutant | LANL Emissions [a] (metric tons per year) |
|---|---|
| Carbon monoxide | 26 |
| Nitrogen dioxide | 85 |
| Sulfur dioxide | 0.7 |
| $PM_{10}$ | 5 |
| VOC | 22 |

$PM_{10}$ = particulate matter less than or equal to 10 microns in aerodynamic diameter.
VOC = Volatile organic compounds. VOC emissions are ozone precursors.
[a] Emissions from the following were included: TA-3 Steam Plant; TA-21 Steam Plant; TA-16 Boilers; TA-48 Boiler; TA-53 Boiler; TA-59 Boiler; paper shredder; TA-3 Asphalt Plant; TA-54 Water Pump; and TA-55 Boilers. The inventory did not include various small sources such as residential-size boilers, standby emergency generators, and small heating units which burn propane or natural gas.
Source: LANL 2002b.

Only a limited amount of monitoring of the ambient air has been performed for nonradiological air pollutants within the LANL region. The NMED operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns ($PM_{10}$) levels (see Table 4.2.3.2–2). LANL and the NMED discontinued operation of this station in FY95 because recorded values were well below applicable standards. Beryllium monitoring performed in 1999 at 9 onsite stations, 10 perimeter stations, and 6 regional stations showed that beryllium levels were low. The New Mexico beryllium ambient standard has been repealed.

**Table 4.2.3.2–2. LANL Nonradiological Ambient Air Monitoring Results**

| Pollutant | Averaging Period | Most Stringent Standard[a] (micrograms per m$^3$) | Ambient Concentrations[b] (micrograms per m$^3$) |
|---|---|---|---|
| Nitrogen dioxide | Annual | 73.7[c] | 4 |
| | 24-hour | 147[c] | 9 |
| Sulfur dioxide | Annual | 41[c] | 2 |
| | 24-hour | 205[c] | 18 |
| | 3-hour | 1,030[d] | Not applicable |
| $PM_{10}$ | Annual | 50[d] | 8 |
| | 24-hour | 150[d] | 29 |
| Ozone | 1-hour | 235[d] | 138 |

$PM_{10}$ = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] 1994 ambient concentrations from monitoring site near Bandelier National Monument at TA-49.
[c] State standard.
[d] Federal standard (NAAQS).
Source: DOE 1999a.

Criteria pollutant concentrations attributable to existing LANL activities were estimated for the LANL SWEIS and are presented in Table 4.2.3.2–3.

For toxic air pollutants, a bounding analysis was performed for the LANL SWEIS (DOE 1999a), indicating that the pollutants of concern for exceeding the guideline values at LANL were emissions from the High Explosives Firing Site operations and emissions that contributed to additive risk from all TAs on receptors near the Los Alamos Medical Center. These combined cancer risks were dominated by the chloroform emissions from the Health Research Laboratory. It was shown that pollutants released under the No Action Alternative in the LANL SWEIS are not expected to cause air quality impacts that would affect human health and the environment (DOE 1999a).

As reported in a special environmental analysis for the Cerro Grande Fire in 2000 (DOE 2000f), there may be some temporary increase in suspended particulate matter as a result of removal of vegetation cover, but air quality would be expected to be within the parameters analyzed in the LANL SWEIS.

In accordance with the *Clean Air Act*, as amended, and New Mexico regulations, the Bandelier Wilderness Area have been designated as a Class I area (i.e., wilderness areas that exceed 4,047 ha [10,000 ac]), where visibility is considered to be an important value (40 CFR 81 and 20 NMAC 2.74) and requires protection. Visibility is measured according to a standard visual range, i.e., how far an image is transmitted through the atmosphere to an observer some distance away. The National Park Service at the Bandelier National Monument has officially monitored visibility in the area since 1988. The view distance at Bandelier Wilderness Area has been recorded from approximately 77-166 km (40-103 mi). The visual range has not deteriorated during the period for which data are available.

**Table 4.2.3.2–3. Modeled Ambient Air Concentrations from LANL Sources**

| Pollutant | Averaging Period | Most Stringent Standard [a] (micrograms per $m^3$) | Maximum Estimated Concentration [b] (micrograms per $m^3$) |
|---|---|---|---|
| Carbon monoxide | 8-hour | 7,800 [c] | 1,440 |
| | 1-hour | 11,700 [c] | 2,710 |
| Lead | Calendar Quarter | 1.5 | 0.00007 |
| Nitrogen dioxide | Annual | 73.7 [c] | 9 |
| | 24-hour | 147 [c] | 90 |
| Sulfur dioxide | Annual | 41 [c] | 18 |
| | 24-hour | 205 [c] | 130 |
| | 3-hour | 1,030 [d] | 254 |
| $PM_{10}$ | Annual | 50 [d] | 1 |
| | 24-hour | 150 [d] | 9 |
| Total Suspended Particulates | Annual | 60 [c] | 2 |
| | 24-hour | 150 [c] | 18 |

$PM_{10}$ = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The more stringent of the Federal and state standards is presented, if both exist, for the averaging period. The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic $PM_{10}$ mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter (μg/$m^3$) with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 m [7,005 ft]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] Based on the Expanded Operations Alternative in the LANL SWEIS. The annual concentrations were analyzed at locations to which the public has access—the site boundary or nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of certain technical areas to which the public has short access.

[c] State standard.

[d] Federal standard (NAAQS).

Source: DOE 1999a.

### 4.2.3.3 Radiological Releases

Radiological air emissions in 2001 from all LANL TAs are presented in Table 4.2.3.3–1. The airborne releases in 2001 were smaller than the annual projections given in the LANL SWEIS (DOE 1999a). The difference in the projected and actual releases is attributable to the fact that the facilities in the areas were operated well below their capacities in 2001.

**Table 4.2.3.3–1. LANL Radiological Airborne Releases to the Environment in 2001[a]**

| Emission Type | Radionuclide | LANL emission (curies) |
|---|---|---|
| Noble gases | Argon-41 | $1.6 \times 10^{1}$ |
| Airborne particulates | Galluim-68 | $1.2 \times 10^{-3}$ |
| | Germanium-68 | $1.2 \times 10^{-3}$ |
| | Arsenic-73 | $4.2 \times 10^{-5}$ |
| | Arsenic-74 | $1.1 \times 10^{-5}$ |
| | Mercury-197 | $1.0 \times 10^{-1}$ |
| | Uranium-234/235/238 | $7.3 \times 10^{-6}$ |
| | Plutonium-238/239/240 | $9.3 \times 10^{-6}$ |
| | Americum-241 | $2.7 \times 10^{-7}$ |
| Halogens | Bromine-76 | $2.6 \times 10^{-4}$ |
| | Bromine-82 | $4.2 \times 10^{-3}$ |
| Nitrogens and oxygens | Nitrogen-13 | $1.3 \times 10^{2}$ |
| Tritium and carbons | Tritium (Hydrogen-3) | $9.4 \times 10^{3}$ |
| | Carbon-11 | $2.0 \times 10^{0}$ |

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table (e.g., short-lived carbon, oxygen, and nitrogen isotopes). Also, not included are radionuclides for which less than $10^{-6}$ curies are released per year.
Source: LANL 2002b.

### 4.2.3.4 Noise

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from the LANL TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within the county and surrounding areas. Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations.

Noise generated by LANL operations, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours (between 7 a.m. and 9 p.m.) and 53 dBA during nighttime hours (between 9 p.m. and 7 a.m.). Between 7 a.m. and 9 p.m., the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any one hour. Activities that do not meet the noise ordinance limits require a permit.

Traffic noise contributes heavily to the background noise heard by humans over most of the county. Although some measurements of sound specifically targeting traffic-generated noise have been made at various county locations in recent studies, these sound levels are found to be highly dependent upon the exact measuring location, time of day, and meteorological conditions. There is, therefore, no single representative measurement of ambient traffic noise for LANL. Noise generated by traffic has been computer modeled to estimate the impact of incremental traffic for various studies, including recent NEPA analyses, without demonstrating meaningful change from current levels due to any new activities. While very few measurements of nonspecific background ambient noise in the LANL area have been made, two such measurements have been taken at a couple of locations near the LANL boundaries next to public roadways. Background noise levels were found to range from 31-35 dBA at the vicinity of the entrance to Bandelier National Monument and NM 4. At White Rock, background noise levels range from 38-51 dBA (1-hour equivalent sound level); this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting. Traffic noise from truck and automobile movements around the LANL TAs is excepted under Los Alamos County noise regulations, as is the traffic noise generated along public thoroughfares within the county.

The detonation of high explosives represents the peak noise level generated by LANL operations. The results of these detonations are air blasts and ground vibrations. The primary source of these detonation activities is the high explosives experiments conducted at the LANL Pulsed High-Energy Radiation Machine Emitting X-Rays Facility and surrounding TAs with active firing sites. Within the foreseeable future, the Dual Axis Radiographic Hydrodynamic Test Facility will begin operation (followed by a corresponding reduction of Pulsed High-Energy Radiation Machine Emitting X-Rays Facility operations) and will become a source of high explosives testing. Air blasts consist of higher-frequency, audible air pressure waves that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower-frequency air pressure waves are not audible, but may cause secondary and audible noises within a testing structure that may be heard by workers. Air blasts and most LANL-generated ground vibrations result from testing activities involving aboveground explosives research. The effects of vibration from existing activities at LANL are discussed further in the LANL SWEIS (DOE 1999a).

The forested condition of much of LANL (especially where explosives testing areas are located), the prevailing area atmospheric conditions, and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for there being little environmental noise pollution or ground vibration concerns to the area resulting from LANL operations. Sudden loud “booming” noises associated with explosives testing are similar to the sound of thunder and may occasionally startle members of the public and LANL workers alike.

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000f).

The Los Alamos County Community Development Department has determined that LANL does not need a special permit under the Los Alamos County Code because noise related to explosives testing is not prolonged, nor is it considered unusual to the Los Alamos community.

### 4.2.4 Water Resources

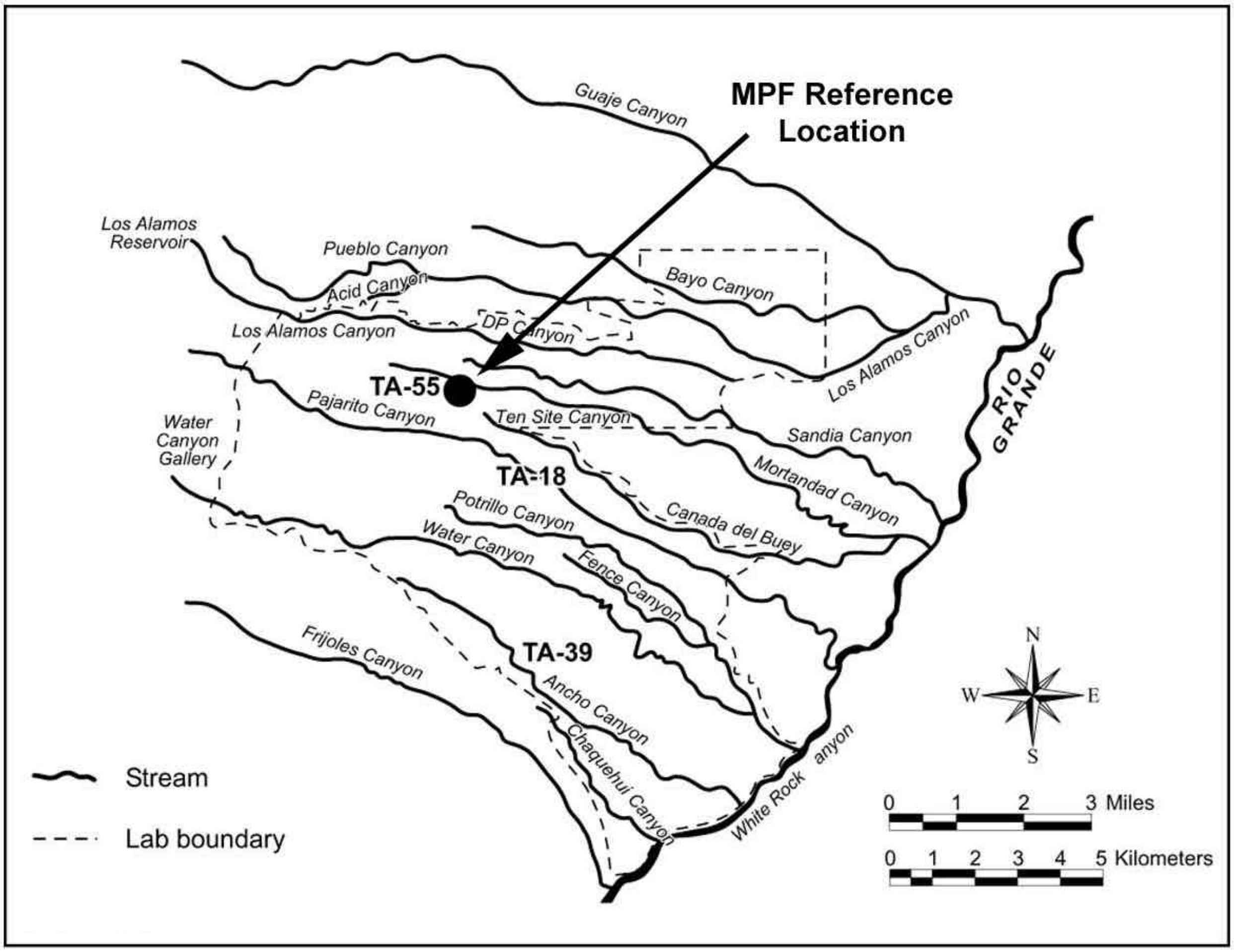
#### 4.2.4.1 Surface Water

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams (i.e., arroyos). Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across LANL before they are depleted by evaporation, transpiration, and infiltration. Figure 4.2.4.1–1 shows the surface water features of the area. Runoff from heavy thunderstorm or heavy snowmelt reaches the Rio Grande River, the major river in north-central New Mexico, several times a year in some drainages. Pueblo, Los Alamos, Sandia, and Mortandad Canyons receive or have received effluents from sanitary sewage, industrial water treatment plants, and cooling-tower blowdown. All of the watersheds in the LANL region are tributaries to an 18-km (11-mi) segment of the Rio Grande between Otowi Bridge and Frijoles Canyon. The Rio Grande passes through Cochiti Lake, approximately 18 km (11 mi) below Frijoles Canyon. The Los Alamos Reservoir, in upper Los Alamos Canyon, has a capacity of 51,000 $m^3$ (41 acre-foot [ac-ft]). The reservoir water was used for recreation, swimming, fishing, and landscape irrigation in the Los Alamos townsite until the Cerro Grande Fire occurred in 2000. The reservoir is now used as a floodwater and silt retention structure and is closed to the public. The Pajarito Plateau Canyons, which serve as collection points for the regional watersheds, originate either along the eastern rim of the Sierra de Los Valles or on the Pajarito Plateau (DOE 2002k).

Within LANL boundaries, only Los Alamos, Pajarito, Water, Ancho, Sandia, Pueblo, and Chaquehui Canyons contain reaches or stream with sections that have continuous flow. Intermittent streams within LANL property are not classified, but are protected by the State of New Mexico for livestock watering and wildlife habitat use (DOE 2002k). Surface water within the boundaries of LANL is not the source for municipal, industrial, or irrigation water, but is used by wildlife that live within, or migrate through, the region.

**Surface Water Quality**

Most of the effluent from LANL is discharged into normally dry arroyos, and LANL is required to meet effluent limitations under the National Pollutant Discharge Elimination System (NPDES) permit program that requires routine monitoring. During 2001, permit compliance was determined from an analysis of 1,085 industrial outfall samples and 134 samples from the Sanitary Wastewater System Facility (Outfall 13S) for parameters including metals, radionuclides, and conventional parameters (e.g., pH, total suspended solids, oil and grease, and biological oxygen demand). Monitoring results were submitted to EPA and NMED. The NPDES permit compliance rate in 2001 for all discharge points was 99.6 percent, with a total of four industrial outfall samples exceeding permit limits (DOE 2002k).




Source: DOE 2002k.

**Figure 4.2.4.1–1. Surface Water Features at LANL**

LANL also operated under 11 NPDES stormwater discharge permits in 2001, including 10 issued for construction activities and one multisector general permit for stormwater discharges associated with industrial activity for which DOE and the University of California are co-permittees. As required under the multisector general permit, LANL performed stormwater monitoring in 2001 and developed and implemented 20 stormwater pollution prevention plans for its industrial activities (DOE 2002k). LANL (with DOE and the University of California as co-permittees) was re-issued a NPDES permit (No. NM0028355) in December 2000 that covers all onsite industrial and sanitary effluent discharges.

As a result of a subsequent outfall reduction program, the number of outfalls requiring monitoring under the permit was reduced from 36 (including 1 sanitary outfall from the Sanitary Wastewater System Facility and 35 industrial wastewater outfalls) to 21 in the recently re-issued permit. This reduction was achieved by removing process flows for seven industrial outfalls and completing the lease transfer of the drinking water system, including nine associated outfalls, to Los Alamos County.

LANL monitors surface waters from regional and Pajarito Plateau stations to evaluate the environmental effects of facility operations. Historical activities and resulting effluent discharges have affected water courses and associated sediments particularly in Acid, Pueblo, Los Alamos, and Mortandad Canyons and, consequently, continue to affect surface water and runoff quality in these areas (DOE 2002k). Surface water grab samples are collected annually from locations where effluent discharges or natural runoff maintains stream flow. Runoff samples are also collected and, since 1996, they have been collected using stream gauging stations, some with automated samplers. Samples are collected when a significant rainfall event causes flow in a monitored portion of a drainage. Many runoff stations are located where drainages cross the LANL boundaries.

In 2001, 44 snowmelt samples and 29 base flow samples were collected. None of the base flow or snowmelt samples analyzed contained radiochemical activities greater than the DOE Derived Concentration Guidelines (DCGs) for public exposure (see Table 4.2.4.1–1). Four samples of snowmelt contained radiochemical activities greater than New Mexico or EPA water quality standards. All of these samples came from areas below historical Laboratory effluent discharges. A sample collected on March 28, 2001 contained 139 pCi/L of dissolved gross beta, which is greater than the EPA primary drinking water standard of 50 pCi/L. The same sample also contained 76.6 pCi/L of dissolved strontium-90, which is greater than EPA primary drinking water standard of 8pCi/L. A different sample collected from another location on April 11, 2001 contained 14.9 pCi/L of dissolved strontium-90. Two unfiltered snowmelt samples collected on March 15 contained up to 26.8 pCi/L of gross alpha, 1.5 to 1.8 times the NM livestock watering standard.

A base flow sample collected on April 18, 2001 contained 12.1 pCi/L of strontium-90 and 92.9 pCi/L of gross beta activity, which are above EPA primary drinking water standards. Americium-241 found in the same sample was 165 pCi/L, which is 5.5 times the DOE drinking water standard of 30 pCi/L. An unfiltered base flow sample collected in 2001 along LANL's western boundary contained gross alpha activity of 16.7 pCi/L, which is greater than the EPA primary drinking water standard and the New Mexico livestock watering standard of 15 pCi/L.

A sample collected on March 28, 2001 contained 632 mg/L of total dissolved solid (TDS), which is above the EPA secondary drinking water standard of 500 mg/L. The total suspended solid (TSS) concentration in base flow and snowmelt samples collected in 2001 were usually less than 400 mg/L, which has no EPA drinking water standard for TSS.

Only one sample analyzed for trace metals contained a metal concentration greater than New Mexico Water Quality Control Commission (NMWQCC) standards for livestock watering or wildlife habitat. The analysis detected selenium at a concentration of 5.6 μg/L, slightly above the NMWQCC standard of 5.0 μg/L.

Storm runoff samples were collected on 30 days during the 2001 season, with over 100 storm runoff samples collected from April through October. The 2001 samples had the highest ever recorded plutonium-239, -240, uranium-234, -235, -238, gross alpha and gross beta concentrations. In most cases, the enhanced radioactivity is attributed to increased storm runoff after the Cerro Grande Fire in 2000. In unfiltered samples, gross alpha were greater than public exposure DCG levels (30 pCi/L) and state of New Mexico livestock watering standards (15 pCi/L) in about three-fourths of all samples collected. The plutonium-239, -240 DCG for public exposure was exceeded in three samples. The calculated plutonium-239, -240 for the suspended sediment carried by these storm runoff events are 4.4 pCi/g, 1.6 pCi/g, and 1.2 pCi/g.

**Table 4.2.4.1–1. LANL Snowmelt and Baseflow Radiological Constituents Sampling of Surface Water in 2001**

| Location and Radioactive Constituent | DCG (or MCL) | Result Range (pCi/L) |
|---|---|---|
| **Los Alamos Canyon** | | |
| Strontium-90 | 1,000 pCi/L | 0.361-14.9 |
| Americum-241 | NS | 0.0379-0.189 |
| Plutonium-239 and Plutonium-240 | 30 pCi/L | 0.048-0.579 |
| Gross Alpha | 15 pCi/L | 22.7-26.8 |
| Gross Beta | 4 mrem/yr | 26.4-165 |
| Tritium | 2,000,000 pCi/L | 184-235 |
| **Sandia Canyon** | | |
| Strontium-90 | 1,000 pCi/L | 0.281-0.325 |
| **Mortandad Canyon** | | |
| Strontium-90 | 1,000 pCi/L | 12.1 |
| Americum-241 | NS | 6.54 |
| Plutonium-239 and Plutonium-240 | 30 pCi/L | 1.52-1.78 |
| Cesium-137 | 200 pCi/L | 10.8 |
| Tritium | 2,000,000 pCi/L | 3140 |
| Gross Beta | 4 mrem/yr | 92.9 |
| **Pajarito Canyon** | | |
| Strontium-90 | 1,000 pCi/L | 0.211-2.47 |
| Cesium-137 | 200 pCi/L | 8.43-8.79 |

MCL= Maximum Contaminant Level; State Primary Water Regulations. MCL is the maximum permissible level of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system.
DCG= DOE Derived Concentration Guides for Water (DOE Order 5400.5). DCG values are based on committed effective dose of 100 millirem per year (mrem/yr); however, because drinking water MCL is based on 4 mrem/yr, value listed is 4 percent of DCG.
NS= No Standard.
Source: LANL 2002b.

All filtered samples contained radionuclide levels below the EPA and DOE drinking water standards, with one exception. One sample contained dissolved strontium-90 at 1.1 times greater than the EPA standard.

For nearly every metal, the level of both filtered (dissolved) and unfiltered (total) storm runoff samples for 2001 were significantly higher than in prior years. As with the radionuclides, the increase in total metals concentrations is largely due to the increased sediment load in runoff after the Cerro Grande Fire. However, it is uncertain what the source of the larger dissolved metals concentration might be. Selenium exceeded the New Mexico wildlife habitat standard of 5 μg/L in nearly half of the unfiltered storm runoff samples. Mercury was detected at levels greater than the New Mexico wildlife habitat standard of 0.77 μg/L at one location. Aluminum concentration in four samples were greater than NMWQCC livestock watering standard and two samples had vanadium concentration greater than NMWQCC livestock watering standard. Two unfiltered samples contained arsenic at levels greater than the EPA arsenic drinking water standard of 10 μg/L.

TSS concentration in storm runoff samples collected in 2001 were highly variable, depending on location and runoff magnitude. The largest TSS concentration were recorded in Guaje and Rendija Canyons, which averaged 78,000 mg/L, with a maximum of 144,000 mg/L.

*Surface Water Quality Effects of the Cerro Grande Fire*

Among the environmental effects produced by the Cerro Grande Fire was an increased potential for stormwater runoff through the canyons that cross LANL property as a result of the loss of vegetation and soil organic matter. During the summer of 2000 and 2001, there was an increase in storm runoff from precipitation. Most storm runoff events at LANL in 2001 were less intense than in 2000, partially because of below normal amounts of precipitation during the summer thunderstorm season and possibly because of partial recovery of fire-impacted areas in the watershed (DOE 2002k).

**Floodplains at LANL**

DOE has delineated all 100-year floodplains within LANL boundaries, which are generally associated with canyon drainages. There are a number of structures within the 100-year floodplain. Most may be characterized as small storage buildings, guard stations, well heads, water treatment stations, and some light laboratory buildings. There are no waste management facilities in the 100-year floodplain. Some facilities are characterized as "moderate hazard" due to the presence of sealed sources or x-ray equipment, but most are designated "low hazard" or "no hazard."

The 500-year floodplain has been designated for Los Alamos Canyon. Overall, the majority of laboratory development is on mesa tops, with only a few facilities located in the canyons (DOE 2002k). Nevertheless, for practical purposes the Cerro Grande Fire has increased the extent of all delineated floodplains in and below burned watershed areas (i.e., predominantly Los Alamos, Sandia, Mortandad, Pajarito, and Water Canyons) due to vegetation loss. This will allow more stormwater runoff to reach the canyon bottom and could subject LANL facilities located within or near the pre-fire delineated floodplain areas to increased erosion or sediment and debris deposition (DOE 2002k).

### 4.2.4.2 Groundwater

Groundwater in the Los Alamos area occurs as perched groundwater near the surface in shallow canyon bottom alluvium and at deeper levels in the main (regional) aquifer (DOE 2002k). Aquifers are classified by Federal and state authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively (DOE 1999g). Class III is not considered a potential source of drinking water and is of limited beneficial use. Most aquifers underlying LANL and the vicinity, except for perched groundwater bodies, are considered Class II aquifers. Alluvial groundwater bodies within LANL boundaries have been primarily characterized by drilling wells on a localized basis where LANL operations are conducted. Wells in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey indicate the presence of alluvial aquifers. Groundwater flow is generally to the east.

Intermediate perched groundwater bodies of limited extent are known to occur within the conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, Sandia, and Mortandad Canyons, in volcanic rocks on the sides of the Jemez Mountains to the west of LANL (from which it discharges at spring heads), and on the western portion of the Pajarito Plateau (DOE 2002k). The location and extent of perched groundwater bodies have not been fully characterized at LANL, but investigations are continuing, and unidentified perched aquifers may exist. The depth to perched groundwater from the surface ranges from approximately 27 m (90 ft) in the middle of Pueblo Canyon to about 137 m (450 ft) in lower Sandia Canyon.

The regional aquifer, below the perched aquifer zone, exists in the sedimentary and volcanic rocks of the Española Basin, with a lateral extent from the Jemez Mountains in the west to the Sangre de Cristo Mountains in the east. The hydrostratigraphic (water-bearing) units comprising the regional aquifer include the interconnected Puye Formation and the Tesuque Formation of the Santa Fe Group. The regional aquifer is hydraulically separated from the overlying alluvial and intermediate perched groundwater bodies by unsaturated volcanic tuff and sedimentary strata, with the regional water table surface lying at a depth below land surface that varies from approximately 366 m (1,200 ft) along the western boundary of the Pajarito Plateau to approximately 183 m (600 ft) along its eastern edge. Thus, these hydrogeologic conditions tend to insulate the regional aquifer from near-surface waste management activities. Water in the regional aquifer is under artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande.

Recharge of the regional aquifer has not been fully characterized and its sources are uncertain. Data suggest that the regional aquifer of the Española Basin is not strongly interconnected across its extent. Recent investigations further suggest that the majority of water pumped to date has been from storage, with minimal recharge of the regional aquifer (DOE 2002k). While the regional aquifer is present beneath all watersheds across the LANL region, it is also generally considered to receive negligible recharge from surface water stream in the watersheds. The regional aquifer is the only body of groundwater in the region that is sufficiently saturated and permeable to transmit economic quantities of water to wells for public use. All drinking water for Los Alamos County, LANL, and Bandelier National Monument comes from the regional aquifer.

Springs in the LANL area originate from alluvial and intermediate perched groundwater bodies and the regional aquifer and occur in the Guaje, Pueblo, Los Alamos, Pajarito, Frijoles, and White Rock Canyon watersheds. In particular, 27 springs discharge from the regional aquifer into White Rock Canyon. A perched aquifer yields a relatively high flow to a former potable water supply gallery in Water Canyon (DOE 2002k).

LANL receives its water from the Los Alamos water supply system, which consists of 12 deep wells, 246 km (153 mi) of main distribution lines, pump stations, storage tanks, and 9 chlorination stations. DOE transferred operation of the system from LANL to the county under a lease agreement in 1998 with a subsequent transfer of ownership in 2001. With the transfer, the county had full responsibility for operating the water system, including ensuring compliance with Federal and state drinking water regulations (LANL 2000c). Under the provisions of the transfer agreement, LANL retained responsibility for operating the distribution system within the site boundaries (DOE 2002k). As part of the transfer agreement, 70 percent of the total water right was assigned to the County, with DOE retaining 30 percent. The DOE-retained portion was then leased to the County. Per the water sales agreement with the County, DOE agrees to purchase, and the County agrees to provide, all of the water needed by the DOE for LANL operations, which is approximately 30 percent of the total water rights (equivalent to about 2.05 billion L [542 million gal] annually).

**Groundwater Quality**

Groundwater monitoring is conducted annually within and near LANL and encompasses the alluvial zone, intermediate perched groundwater zone, regional aquifer, supply wells, and springs. The LANL *Resource Conservation and Recovery Act* (RCRA) permit specifically requires monitoring of the canyon alluvial groundwater system in Pueblo, Los Alamos, Sandia, Mortandad, Potrillo, Fence, and Water Canyons. One of the objectives of LANL's Environmental Surveillance and Compliance Programs is to provide indications of the potential for human and environmental exposure from contaminated groundwater resources. Groundwater may accumulate contaminants from discharges to surface water or from leakage of liquid effluent storage system.

Sampling for radiological constituents in the regional aquifers in 2001 shows that all of the results were below DOE DCG standards. There are no Federal or state radiological standards for the constituents detected (see Table 4.2.4.2–1). DCGs reflect the concentrations of individual nuclides in water or air that would result in an effective dose equivalent of 100 millirem per year (mrem/yr) caused by ingestion of water or inhalation of air at average annual intake rates. DCGs are not exposure limits, but are simply reference values provided to allow for comparisons of radionuclide concentrations in environmental media. Most of the results were near or below the detection limits of the analytical method used.

The test wells in the regional aquifer showed levels of several nonradiological constituents that approach or exceed standards for drinking water distribution systems (test wells are for monitoring purposes only and are not part of the water supply system). In 2001, iron approached or exceeded the EPA secondary drinking water standards for four test wells and exceeded the New Mexico groundwater standard in one test well. Manganese approached or exceeded the EPA secondary drinking water standard in two test wells. Two test wells had lead concentrations above the EPA action level, and one test well had an aluminum concentration above the EPA secondary drinking water standard.

During 2001, nitrate concentrations in alluvial groundwater at only one well were above the New Mexico nitrate groundwater standard of 10 mg/L. Fluoride concentrations at two wells exceeded NMWQCC groundwater standard of 1.6 mg/L. Perchlorate was detected in groundwater at every alluvial groundwater well sampled in 2001. Perchlorate concentrations ranged from 53 μg/L to 220 μg/L (there is no drinking water standard for perchlorate). The Cerro Grande Fire caused high manganese, aluminum, and iron concentrations in many alluvial perched groundwater samples. One sample had high aluminum and iron values, probably related to a high TSS of about 25 mg/L. Higher than usual manganese concentrations were found in Pueblo Canyon and Pajarito Canyon, which were both extensively burned in the Cerro Grande Fire (LANL 2002b).

**Table 4.2.4.2–1. LANL Radiological Constituent Sampling of Groundwater**

| Location and Radioactive Constituent | DCG (pCi/L) | Result Ranges (pCi/L) |
|---|---|---|
| **Regional Aquifer Wells** | | |
| Tritium | 2,000,000 | -133-186 |
| Strontium-90 | 1,000 | -0.71-0.0571 |
| Cesium-137 | 200 | -0.232-2.3 |
| Uranium-234 | 500 | 0.0352-1.94 |
| Uranium-235 and Uranium-236 | 600 | 0.0023-0.0562 |
| Uranium-238 | 600 | 0.0222-1.07 |
| **Los Alamos Canyons** | | |
| Tritium | 2,000,000 | -27.9-455 |
| Strontium-90 | 1,000 | 0.0478-52.1 |
| Cesium-137 | 200 | -1.33-0.964 |
| Uranium-234 | 500 | 0.0044-0.168 |
| Uranium-235 and Uranium-236 | 600 | -0.00325-0.0245 |
| Uranium-238 | 600 | 0.00442-0.0444 |
| **Mortandad Canyon** | | |
| Tritium | 2,000,000 | 4,790-6,690 |
| Strontium-90 | 1,000 | -0.82-38.1 |
| Cesium-137 | 200 | -0.768-3.81 |
| Uranium-234 | 500 | 0.887-0.917 |
| Uranium-235 and Uranium-236 | 600 | 0.0361-0.0825 |
| Uranium-238 | 600 | 0.292-0.333 |
| **Pajarito Canyon** | | |
| Tritium | 2,000,000 | -85.5-28.6 |
| Strontium-90 | 1,000 | 0.107-0.393 |
| Cesium-137 | 200 | -0.079-0.942 |
| Uranium-234 | 500 | 0.386-1.08 |
| Uranium-235 and Uranium-236 | 600 | -0.0142-0.0694 |
| Uranium-238 | 600 | -0.014-0.869 |
| **Santa Fe Water Supply Wells** | | |
| Tritium | 2,000,000 | ND |
| Strontium-90 | 1,000 | -0.0861-0.146 |
| Cesium-137 | 200 | ND |
| Uranium-234 | 500 | 3.49-92.6 |
| Uranium-235 and Uranium-236 | 600 | 0.113-0.692 |
| Uranium-238 | 600 | 0.67-6.79 |

MCL= Maximum Contaminant Level; State Primary Water Regulations.
DCG= DOE Derived Concentration Guides for Water (DOE Order 5400.5). DCG values are based on committed effective dose of 100 millrem per year; however, because drinking water MCL is based on 4 mrem/yr, value listed is 4 percent of DCG.
ND = No Data.
Source: LANL 2002b.

## 4.2.5 Geology and Soils

### 4.2.5.1 Geology

LANL and the communities of Los Alamos and White Rock are located on the Pajarito Plateau in the Jemez Mountains of north-central New Mexico (see Figure 4.2.1.1–1). The Pajarito Plateau is 13-26 km (8-16 mi) wide and 48-64 km (30-40 mi) long, lying between the Jemez Mountains to the west and the Rio Grande to the east (DOE 1999a). The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west oriented canyons that drain toward the Rio Grande River. The representative site being evaluated for the MPF is on the top of one of these mesas.

A primary geologic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The north-trending Pajarito Fault system is part of the Rio Grande Rift and consists of a group of interconnecting faults that are nearly parallel (see Figure 4.2.5.1–1).

Rocks in the LANL region were predominantly produced by volcanic and sedimentary processes.

#### Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at LANL and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

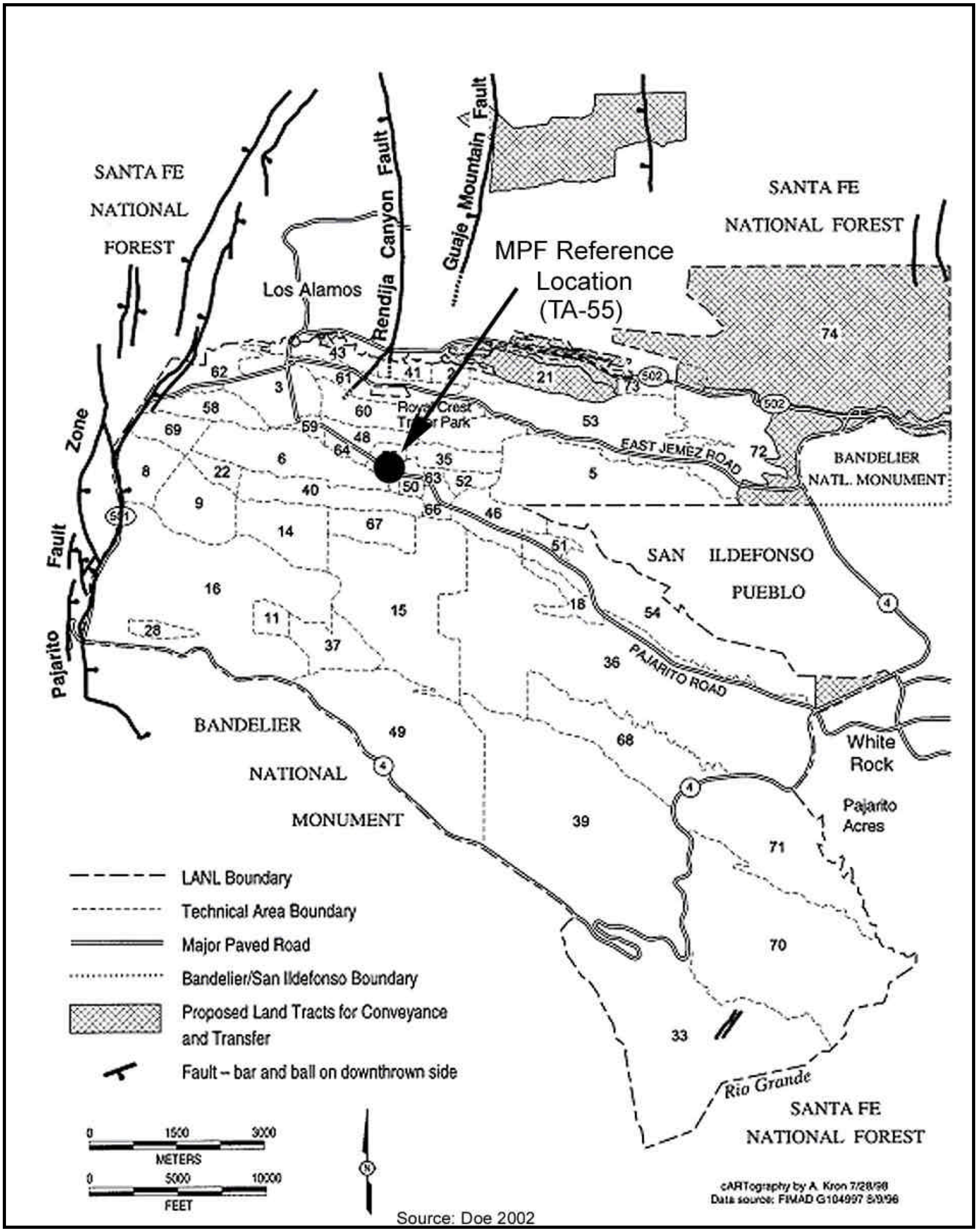
*Volcanism*

Volcanism in the Jemez Mountains' volcanic field, west of LANL, has a 13 million-year history. The Jemez Mountains currently show an unusually low amount of seismic activity, which suggests that no magma migration is occurring. Seismic signals may be partially absorbed deep in the subsurface due to elevated temperatures and high heat flow. Such masking of seismic signals would add difficulty in predicting volcanism in the LANL area. There are plans to install additional seismograph stations in the vicinity of the Valles Caldera to improve predictive capabilities (DOE 1999a).

*Seismic Activity*

A comprehensive seismic hazards study was completed in 1995 at LANL (DOE 1999a). This study provided estimates of the ground-shaking hazards and the resulting ground motions that may be caused by these earthquake sources.

The major faults in Los Alamos County are the Pajarito, Rendija Canyon, and Guaje Mountain Faults, and their characteristics are summarized in Table 4.2.5.1–1. Fault locations are shown on Figure 4.2.5.1–1.




Source: DOE 2002k.

**Figure 4.2.5.1–1. Major Surface Faults in the Los Alamos Region**

**Table 4.2.5.1–1. Summary of Major Faults in the LANL Region**

| Name | Approximate Length (mi) | Type | Most Recent Movement | Maximum Earthquake[a] Potential |
|---|---|---|---|---|
| Pajarito Fault Zone | 26 | Normal, down-to-the-east[b] | Approximately 45,000 to 55,000 years ago | 7 |
| Rendija Canyon Fault | 6 | Normal, down-to-the-west | 8,000 to 9,000 or 23,000 years ago | 6.5 |
| Guaje Mountain Fault | 8 | Normal, down-to-the-west | 4,000 to 6,000 years ago | 6.5 |

[a] Richter magnitude.
[b] The crustal block on the east side of the Pajarito Fault slips downward toward the east when fault movement occurs. This results in a fault plane for the Pajarito Fault, for example, that runs under LANL toward the east. A normal west fault involves the crustal block on the west side of the fault slipping downward toward the west.
Source: DOE 1999a.

The seismic hazards results indicate that the Pajarito Fault system represents the greatest potential seismic risk to facilities at LANL, with an estimated maximum earthquake Richter magnitude of about 7. Although large uncertainties exist, an earthquake with a Richter magnitude greater than or equal to 6 is estimated to occur once every 4,000 years; an earthquake with a magnitude greater than or equal to 7 is estimated to occur once every 100,000 years along the Pajarito Fault system. Earthquakes of this magnitude have an associated Modified Mercalli Intensity of IX and X, causing considerable damage to structures and underground pipes. Table 4.2.5.1–2 defines the Modified Mercalli Scale and approximate correlations to the Richter Scale.

*Slope Stability, Subsidence, and Soil Liquefaction*

The topography of this area is rugged. The nearly flat, gently sloped mesa tops are cut by deep canyons. In some cases, the canyon slopes are nearly vertical. Rockfalls and landslides are two geologic processes related to slope stability in the area. The primary risk factors most likely to affect slope stability are wall steepness, canyon depth, and stratigraphy. Because of this, land near a cliff edge or in a canyon bottom is potentially susceptible to slope instability. The largest slope instability may be triggered by any process that might destabilize supporting rocks. These processes include, but are not limited to, excessive rainfalls, erosion, and seismic activity.

Subsidence (lowering of the ground surface) and soil liquefaction are two geologic processes that are less likely to affect LANL than rockfalls or landslides. The potential for subsidence is minimal due to the firm rock beneath LANL. Bedrock, soils, and unconsolidated deposits that are unsaturated, such as those that occur beneath LANL, are unlikely to undergo liquefaction.

### 4.2.5.2 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Soils that formed on mesa tops of the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal soil series (DOE 1999a). Soils consisting of sediments derived from the mesa tops occur along most

**Table 4.2.5.1–2. The Modified Mercalli Intensity Scale of 1931, with Approximate Correlations to the Richter Scale and Maximum Ground Acceleration[a]**

| Modified Mercalli Intensity[b] | Observed Effects of Earthquake | Approximate Richter Magnitude[c] | Maximum Ground Acceleration[d] |
|---|---|---|---|
| I | Usually not felt. | <2 | negligible |
| II | Felt by persons at rest, on upper floors or favorably placed. | 2-3 | <0.003 g |
| III | Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake. | 3 | 0.003 to 0.007 g |
| IV | Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak. | 4 | 0.007 to 0.015 g |
| V | Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start. | 4 | 0.015 to 0.03 g |
| VI | Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake. | 5 | 0.03 to 0.09 g |
| VII | Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well-built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof line; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides; large bells ring. | 6 | 0.07 to 0.22 g |
| VIII | Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes. | 6 | 0.15 to 0.3 g |
| IX | General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks. | 7 | 0.3 to 0.7g |
| X | Most masonry and frame structures destroyed; some well-built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent | 8 | 0.45 to 1.5 g |
| XI | Rails bent greatly; underground pipelines completely out of service. | 9 | 0.5 to 3 g |
| XII | Damage nearly total; large rock masses displaced; objects thrown into air; lines of sight distorted. | 9 | 0.5 to 7 g |

[a] This table illustrates the approximate correlation between the Modified Mercalli Intensity Scale, the Richter Scale, and maximum ground acceleration.
[b] Intensity is a unitless expression of observed effects.
[c] Magnitude is an exponential function of seismic wave amplitude, related to the energy released.
[d] Acceleration is expressed in relation to the earth's acceleration due to earth’s gravity (g).
Source: DOE 2001e.

segments of LANL canyons as narrow bands of canyon-bottom deposits, which can be transported by surface water during runoff events.

All of the soils in the aforementioned soil series are well-drained and range from very shallow (0-25 cm [0-10 in]) to moderately deep (51-102 cm [20-40 in]), with the greatest depth to the underlying Bandelier Tuff being 102 cm (40 in) (DOE 1999a). There are no prime farmlands at LANL (LANL 1996).

**Soil Erosion**

Soil erosion can have serious consequences to the maintenance of biological communities and also can be a mechanism for moving contaminants across LANL and off the site. Soil erosion rates normally vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels and areas of steep slopes and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels (DOE 1999a).

Areas where runoff is concentrated by roads and other structures are especially prone to high erosion rates. The Cerro Grande Fire, which started in May 2000, burned approximately 17,401 ha (43,000 ac) along the eastern flank of the Pajarito Plateau destroying much of the forest canopy and ground cover above these soils. In addition, the fire also altered soil characteristics that further increased the potential for erosion. As part of the emergency response actions taken during and immediately after the Cerro Grande Fire, sites were recontoured, reseeded, mulched, and hydromulched. Silt fences were installed to allow seedlings to take hold. In strategic places, rock and log check dams were installed. LANL and surrounding communities remain more vulnerable to the occurrence of flooding, mudflows, and avalanche (DOE 2000f).

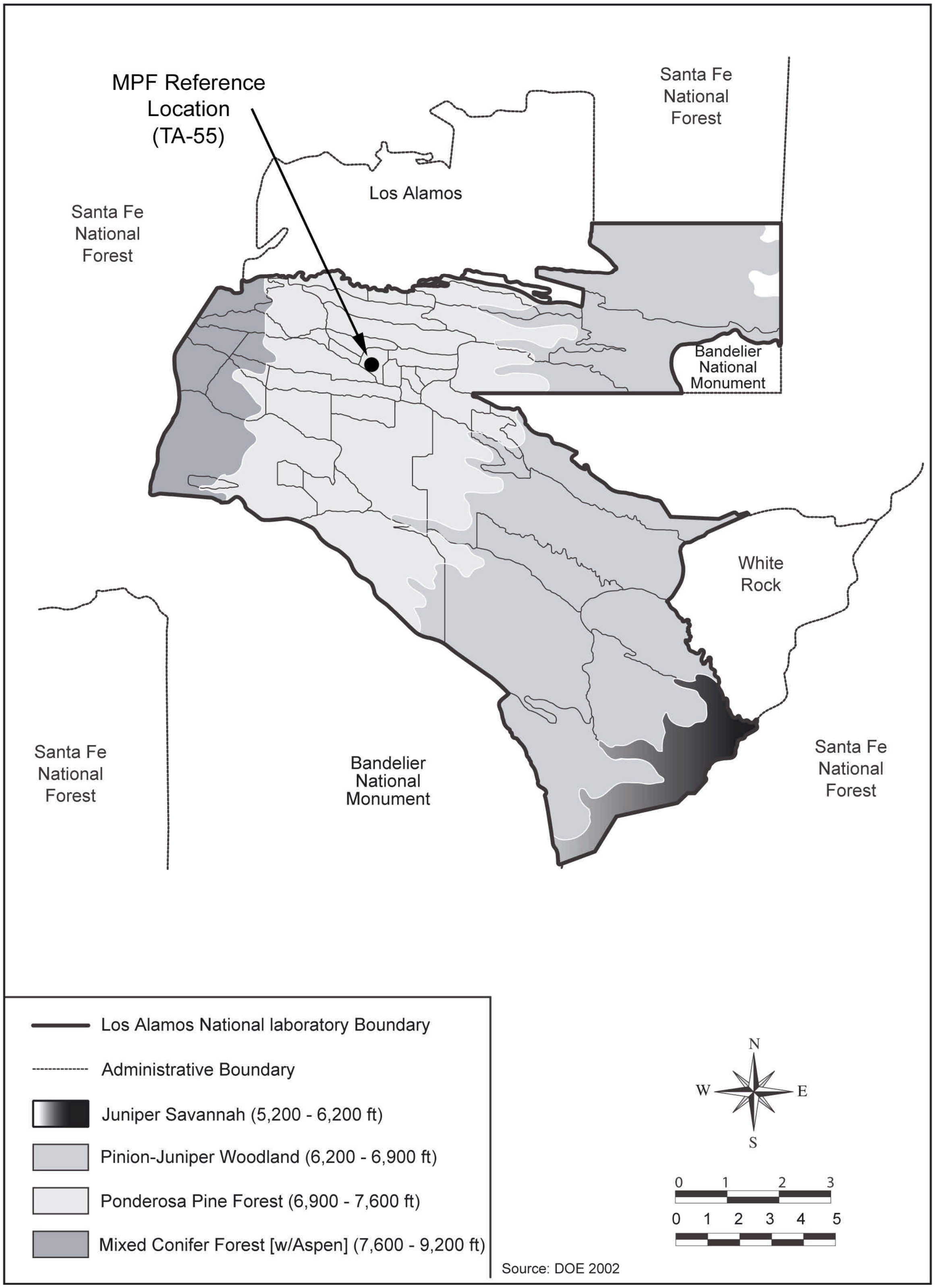
**Mineral Resources**

There are no active mines, mills, pits, or quarries in Los Alamos County or on DOE land at LANL. Sand, gravel, and pumice are mined throughout the surrounding counties.

### 4.2.6 Biological Resources

#### 4.2.6.1 Terrestrial Resources

LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site are quite diverse, due partly to the 1,525-m (5,000-ft) elevation gradient from the Rio Grande River on the southeastern boundary to the Jemez Mountains, which are 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed (DOE 2002k). In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). The remaining land has been classified into four major vegetation zones, which are defined by the dominant plants present, and occur within specific elevation zones. These include mixed conifer forest, ponderosa pine (*Pinus ponderosa*) forest, pinyon (*P. edulis*)-juniper (*Juniperus* spp.) woodland, and juniper savannah (see Figure 4.2.6.1–1). The vegetative communities on and near LANL are very diverse, with over 900 species of vascular plants identified in the area.




Source: DOE 2002k.

**Figure 4.2.6.1–1. Los Alamos National Laboratory Vegetation Zones**

Terrestrial animals associated with vegetation zones in the LANL area include 57 species of mammals, 200 species of birds, 28 species of reptiles, and 9 species of amphibians. Common animals found on LANL include the collared lizard (*Crotaphytus collaris*), eastern fence lizard (*Sceloporus undulatus*), black-headed grosbeak (*Pheucticus melanocephalus*), western bluebird (*Sialia mexicana*), elk (*Cervus elephus*), and raccoon (*Procyon lotor*) (DOE 2002k). The most important and prevalent big game species at LANL are mule deer (*Odocoileus hemionus*) and elk (*Cervus elephas*).

The native populations of Rocky Mountain elk were eliminated from the entire State of New Mexico by 1909. In 1948, 28 elk were reintroduced into the Jemez Mountains, and an additional 58 elk were reintroduced into Los Alamos County from 1964-1965. The Jemez Mountain elk population, since 1997-2002, has fluctuated around 4,400-6,500 animals. Hunting is not permitted on LANL. Numerous raptors, such as the red-tailed hawk (*Buteo jamaicensis*) and great-horned owl (*Bubo virginianus*), and carnivores, such as the black bear (*Ursus americanus*) and bobcat (*Lynx rufus*), are also found on LANL. A variety of migratory birds have been recorded at the site.

The Cerro Grande Fire dramatically altered the habitat of many animals when it burned across 3,110 ha (7,684 ac) of forest area within LANL. Additionally, fire suppression activities resulted in the clearing of an additional 52 ha (130 ac). While initially eliminating or fragmenting the habitats of many animals (e.g., reptiles, amphibians, small mammals, and birds), with time, the effects of the fire will also increase and improve the habitat for other species (e.g., large mammals) by creating more foraging areas. During the fire, individuals of many species died. Population recovery is expected within the next several breeding seasons. Elk and mule deer populations are expected to increase in the next several years in response to the additional foraging areas resulting from the post-fire vegetation regrowth (DOE 2002k).

Throughout LANL's history, developments within various TAs have caused significant alterations in the terrain and the general landscape of the Pajarito Plateau. These alterations have resulted in significant changes in land use by most groups of wildlife, particularly birds and larger mammals that have large seasonal and/or daily ranges. Certain buildings or building complexes required the segregation of large areas such as mesa tops and, in some cases, these project areas were secured by fences around their perimeters. These alterations have caused some species of wildlife, such as elk and mule deer, to alter their landuse patterns by cutting off or changing seasonal or daily travel corridors to wintering areas, breeding habitats, foraging habitats, and breeding areas (DOE 2002k).

TA-55 is located in the ponderosa pine forest vegetation zone; however, 43 percent of the site is developed. Animal species likely to be present in this area include the prairie lizard (*Sceloporus undulates*), white-breasted nuthatch (*Sitta carolinensis*), Audubon's warbler (*Dendroica coronata*), deer mouse (*Peromyscus maniculatus*), and raccoon. Due to the presence of security fencing, no large animals would be found within developed portions of TA-55.

### 4.2.6.2 Wetlands

A 1996 field study identified an estimated 20 ha (50 ac) of wetlands within LANL. The LANL survey determined that more than 95 percent of the identified wetlands are located in the Sandia, Mortandad, Pajarito, and Water Canyon watersheds.

Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of Federal- and state-listed species. The majority of the wetlands in the area are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. There are also some springs bordering the Rio Grande River within White Rock Canyon. Cochiti Lake, located downstream from LANL, supports lake-associated wetlands.

Currently, about 5 ha (13 ac) of wetlands within LANL boundaries are caused or enhanced by process effluent wastewater from 21 NPDES-permitted outfalls. These artificially created wetlands are afforded the same legal protection as wetlands that stem from natural sources. In 1996, the effluent from NPDES outfalls, both stormwater and process water, contributed 407 million L (108 million gal) to wetlands within LANL boundaries, and nearly half of the outfalls are probable sources of drinking water for large mammals.

During the Cerro Grande Fire, 6.5 ha (16 ac), or 20 percent of the wetlands occurring on LANL, were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Secondary effects from the fire to wetlands may also occur as a result of increased runoff due to the loss of vegetation. Wetlands were not disturbed by fire suppression activities; however, a number of projects were undertaken after the fire to control runoff and erosion. Two projects involving the enlargement of culverts in lower Pajarito Canyon, one about 0.4 km (0.25 mi) downstream from TA-18 and the other at NM 4, resulted in removal of about 0.6 ha (1.5 ac) of wetland vegetation composed primarily of willow trees. Wetland vegetation is likely to regenerate over the next several years if the area is not silted in or scoured away by floodwaters (DOE 2002k).

There are three wetlands located within TA-55. These wetlands result from natural sources and are characterized by riparian vegetation and faunal components. Wetland plant species present include rush (*Juncus* spp.), willow (*Salix* spp.), and broad-leafed cattail (*Typha latifolia*). Animals observed using this wetland include the many-lined skink (*Eumeces multivigratus*), western chorus frog (*Pseudacris triseriata*), red-winged blackbird (*Agelaius phoeniceus*), violet-green swallow (*Tachycineta thalassiana*), long-tailed vole (*Iklicrotus longicaudus*), and vagrant shrew (*Sorex vagrans*).

### 4.2.6.3 Aquatic Resources

While the Rito de Los Frijoles in Bandelier National Monument (located to the south of LANL) and the Rio Grande are the only truly perennial streams in the region, several of the canyon floors on LANL contain reaches of perennial surface water, such as the perennial streams draining lower Pajarito and Ancho Canyons to the Rio Grande. Surface water flow occurs in canyon bottoms seasonally, or intermittently, as a result of spring snowmelt and summer rain. A few short sections of riparian vegetation of cottonwood, willow, and other water-loving plants are present in scattered locations on LANL, as well as along the Rio Grande in White Rock Canyon. The springs and streams at LANL do not support fish populations; however, many other aquatic species are present in these waters, i.e., insects and amphibians (DOE 2002m). Terrestrial wildlife use onsite streams for drinking and associated riparian habitat for nesting and feeding. There are no aquatic resources located in TA-55.

#### 4.2.6.4 Threatened and Endangered Species

A number of regionally protected and sensitive (rare or declining) species have been documented in the LANL region (see Table 4.2.6.4–1). These consist of 3 federally-endangered species (the whooping crane [*Grus americana*], southwestern willow flycatcher [*Empidonax traillii eximus*], and the black-footed ferret [*Mustela nigripes*]), 2 federally-threatened species (the bald eagle [*Haliaeetus leucocephalus*] and Mexican spotted owl [*Strix occidentalis lucida*]), and 19 species of concern (species that may be of concern to U.S. Fish and Wildlife Service [USFWS] but have not received recognition under the *Endangered Species Act*, and that the USFWS encourages agencies to include in NEPA studies). Species listed as endangered, threatened, rare, or sensitive by the State of New Mexico are also included in Table 4.2.6.4–1. The New Mexico "sensitive" taxa are those taxa that deserve special consideration in management and planning, and are not listed as threatened or endangered by the State of New Mexico. In addition, critical habitat for the threatened Mexican spotted owl has been designated on Santa Fe National Forest lands that are contiguous with LANL's western boundary.

As mentioned in Section 4.2.6.2, there are three wetlands at TA-55. Threatened and endangered species and species of concern that are associated with these types of wetlands and which may be found in the vicinity include the Northern goshawk, which is listed as a species of concern, the federally-threatened Mexican spotted owl, the state-threatened spotted bat, the federally-endangered southwestern willow flycatcher, and the checkered lily, which is also listed as a species of concern.

In addition, TA-55 contains core and buffer Areas of Environmental Interest for the Mexican spotted owl. Areas of Environmental Interest are established under LANL's Habitat Management Plan (LANL 1998) and are areas within LANL that are being managed and protected because of their significance to biological or other resources. Habitats of threatened and endangered species that occur or may occur at LANL are designated as Areas of Environmental Interest. In general, an Area of Environmental Interest consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the area from disturbances that would degrade the value of the core area to the species.

**Table 4.2.6.4–1. Listed Threatened and Endangered Species of Concern, and Other Unique Species that Occur or May Occur at LANL**

| Species | Federal Classification | State Classification | Occurrence on LANL |
|---|---|---|---|
| **Mammals** | | | |
| American marten *Martes americana origenes* | Unlisted | Threatened | Reported without verification in the Jemez Mountains; habitat not present on LANL |
| Big free-tailed bat *Nyctinomops macrotis* | Special Concern | Special Concern | Migratory visitor |
| Fringed myotis *Myotis thysanodes* | Special Concern | Special Concern | Observed on LANL, BNM, and SFNF lands |
| Goat peak pika *Ochotona princeps nigrescens* | Special Concern | Special Concern | Observed on LAC and BNM lands |
| Long-eared myotis *Myotis evotis* | Special Concern | Special Concern | Summer resident |
| Long-legged myotis *Myotis volans* | Special Concern | Special Concern | Summer resident |
| New Mexico jumping mouse *Zapus hudsonius luteus* | Special Concern | Threatened | Permanent resident on LAC and SFNF lands |
| Occult little brown bat *Myotis lucifugus occultus* | Special Concern | Special Concern | Observed on SFNF lands |
| Pale Townsend's big-eared bat *Plecotus townsendii pallescens* | Special Concern | Special Concern | Observed LANL and BNM lands |
| Small-footed myotis *Myotis ciliolabrum* | Special Concern | Special Concern | Observed LANL, BNM, and SFNF lands |
| Spotted bat *Euderma maculatum* | Special Concern | Threatened | Permanent resident on BNM and SFNF lands; Seasonal resident on LANL |
| Yuma myotis *Myotis yumanensis* | Special Concern | Special Concern | Summer resident |
| **Birds** | | | |
| American peregrine falcon *Falco peregrinus aratum* | Special Concern | Threatened | Forages on LANL |
| Baird's sparrow *Ammodramus bairdii* | Special Concern | Threatened | Observed on SFNF lands |
| Bald eagle *Haliaeetus leucocephalus* | Threatened | Threatened | Winter visitor |
| Ferruginous hawk *Buteo regalis* | Special Concern | Protected | Observed as a breeding resident |
| Gray vireo *Vireo vicinior* | Special Concern | Threatened | Observed on LAC, BNM, and SFNF lands |

**Table 4.2.6.4–1. Listed Threatened and Endangered Species of Concern, and Other Unique Species that Occur or May Occur at LANL (*continued*)**

| Species | Federal Classification | State Classification | Occurrence on LANL |
|---|---|---|---|
| **Birds *(continued)*** | | | |
| Loggerhead shrike<br>*Lanius ludovicianus* | Special Concern | Special Concern | Observed on LAC, BNM, and SFNF lands |
| Mexican spotted owl<br>*Strix occidentalis lucida* | Threatened | Special Concern | Breeding resident on LANL, LAC, BNM, and SFNF lands; Critical habitat designated on SFNF lands |
| Northern goshawk<br>*Accipiter gentilis* | Special Concern | Special Concern | Observed as a breeding resident |
| Southwestern willow flycatcher<br>*Empidonax traillii eximus* | Endangered | Endangered | Potential presence on LANL and White Rock Canyon; Potential nesting area on LANL; Present in Jemez Mountains; Present in riparian zone near Espanõla |
| White-faced ibis<br>*Plegadis chihi* | Special Concern | Unlisted | Summer resident |
| Whooping crane<br>*Grus americana* | Endangered | Endangered | Potential migration winter visitor within Rio Grande rift valley |
| **Amphibians** | | | |
| Jemez Mountain Salamander<br>*Plethodon neomexicanus* | Special Concern | Threatened | Permanent resident |
| **Fish** | | | |
| Flathead club<br>*Platygobio gracilis* | Special Concern | Unlisted | Permanent resident of the Rio Grande between Espanõla and the Cochiti Reservoir |
| **Plants** | | | |
| Checkered lily<br>*Fritillaria atropurpurca* | Unlisted | Special Concern | Observed on LAC, BNM, and SFNF lands |
| Helleborine orchid<br>*Epipactis gigantea* | Unlisted | Special Concern | Rare |
| Wood lily<br>*Lilium philadelphicum*<br>var. *andinum* | Unlisted | Endangered | Observed on LAC, BNM, and SFNF lands |
| Yellow lady's slipper orchid<br>*Cyprepedium calceolus*<br>var. *pubescens* | Unlisted | Endangered | Observed on BNM lands |
| **Invertebrates** | | | |
| Pearly Chesterspot Butterfly<br>*Charidryas acastus* | Special Concern | Unlisted | Potential occurrence in SFNF |

LAC = Los Alamos County.
BNM = Bandelier National Monument.
SFNF = Santa Fe National Forest.
Source: DOE 2002k.

It is unlikely that the results of the Cerro Grande Fire will cause a long-term change to the overall number of federally-listed threatened and endangered species inhabiting the region. However, it is likely that the results of the fire will change the distribution and movement of various species, including the Mexican spotted owl. The areas of LANL that have been proposed as critical habitat suffered heavy damage during the fire. Specifically, two primary areas considered as critical habitat for the Mexican spotted owl located on U.S. Forest Service land near LANL suffered almost 100 percent vegetation mortality. The fire may also have long-term effects on the habitat of several state-listed species, including the Jemez Mountain salamander. As noted in Section 4.2.6.2, two projects undertaken after the fire to enlarge culverts in the lower Pajarito Canyon disturbed about 0.6 ha (1.5 ac) of wetland vegetation composed primarily of willow trees. This wetland habitat area is used by the southwestern willow flycatcher at LANL. It was not, however, a confirmed nesting habitat and was of marginal quality (DOE 2000f).

### 4.2.7 Cultural and Paleontological Resources

#### 4.2.7.1 Cultural Resources

All undertakings at LANL are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the *National Historic Preservation Act* (NHPA), and DOE orders and policies that address cultural resource protection and management. LANL compliance procedures are outlined in the *LANL Cultural Resource Overview and Data Inventory 1995* (LANL 1995b). Management of the site's cultural resources is augmented through consultation with Native American tribes, particularly through the Pueblo Accord agreements signed in 1992 by DOE and the Pueblos of Jemez, Cochiti, San Ildefonso, and Santa Clara. Also, DOE and LANL are active participants in the East Jemez Resource Council, formed to foster conservation and preservation of the natural and cultural resources of the east Jemez Mountains. The ROI for cultural resources is the entire LANL site.

**Prehistoric Resources**

Archaeological surveys have been conducted of approximately 90 percent of the land within LANL, with 85 percent of the area surveyed receiving 100 percent coverage, to identify cultural resources present. A total of 1,777 prehistoric sites has been recorded on LANL (DOE 2003). These sites include multiroom pueblos, field houses, talus houses, caveates, rock shelters, shrines, animal traps, hunting blinds, water control features, agricultural fields and terraces, quarries, rock art, trails, and limited activity sites (DOE 1996c). Of these sites, 439 have been evaluated for eligibility for listing on the National Register of Historic Places (NRHP). Of the evaluated sites, 379 sites have been determined eligible for listing, 2 sites as potentially eligible, and 60 sites as not eligible. The remaining 1,338 sites that have not been evaluated are treated as though potentially eligible until they are evaluated (DOE 2003).

**Historic Resources**

Historic resources identified at LANL include: 1 from the U.S. Territorial period, 9 from the Statehood period, 71 from the Homestead period, 5 from the Post-Homestead period, 1 from the Historic Pueblo period, 36 from the undetermined Historic period, 56 from the Manhattan

Project period, and 527 from the Early and Late Cold War periods. Thus, a total of 706 historic resources have been identified at LANL. Some of these resources have been recorded through site surveys, and others were identified by reviewing construction documents and the site cultural resources database.

**Native American Resources**

Consultations to identify traditional cultural properties and sacred sites were conducted with 19 Native American tribes and two Hispanic communities in connection with the preparation of the LANL SWEIS (DOE 1999a). These consultations identified 15 ceremonial archaeological sites, 14 natural features, 10 ethnobotanical sites, 7 artisan material sites, and 8 subsistence features of importance on LANL (DOE 2002k). In addition to tangible cultural entities, concern has been expressed that "spiritual," "unseen," or "undocumentable" aspects can be present at LANL that are an important part of Native American culture and may be adversely impacted by LANL's presence and operations (DOE 1999a). Additional consultations regarding traditional cultural properties and sacred sites are ongoing for LANL. In 1992, DOE entered into formal agreements, called the Pueblo Accords, with four nearby pueblos (Jemez, Cochiti, San Ildefonso, and Santa Clara). These accords contain provisions for coordination among the four pueblos and DOE to improve communication and cooperation between the Federal and tribal governments (DOE 1999a).

**Cultural Resources on the Reference Location**

The reference location at LANL is located in TA-55. Approximately half of this TA-55 has been disturbed during development of various facilities and infrastructure. All of TA-55 has been surveyed for cultural resources. TA-55 contains 11 historic resources. The New Mexico State Historic Preservation Officer (SHPO) has concurred that one of these resources is eligible for listing on the NRHP and two resources are not eligible. The remaining eight resources have not yet been evaluated (DOE 2003).

### 4.2.7.2 Paleontological Resources

The Pajarito Plateau consists primarily of Pleistocene volcanic tuffs and compacted pumice and ashfalls of the Bandelier Formation. This formation was not conducive to preserving ancient plant and animal remains because the deposits were extremely hot when deposited (DOE 2002k, DOE 1999g). None of the formations at Bandelier are known to be fossiliferous (DOE 1996c). One paleontological resource has been found within LANL boundaries, but not in TA-55 (DOE 2003).

### 4.2.8 Socioeconomics

Socioeconomic characteristics addressed at LANL include employment, income, population, housing, and community services. These characteristics are analyzed for a three-county ROI consisting of Los Alamos, Rio Arriba, and Santa Fe Counties in New Mexico, where almost 90 percent of site employees reside (DOE 2002k), as shown in Table 4.2.8–1.

**Table 4.2.8–1. Three-County ROI Where LANL Employees Reside**

| County | Number of Employees | Percent of Total |
|---|---|---|
| Los Alamos | 5,381 | 50.8 |
| Rio Arriba | 2,149 | 20.3 |
| Santa Fe | 1,967 | 18.6 |
| **ROI Total** | **9,497** | **89.7** |

Source: DOE 2002k.

### 4.2.8.1 Employment and Income

The service sector employs the greatest number of workers in the ROI with more than 35 percent of the workforce. Other important sectors of employment include government (25 percent); retail trade (16.9 percent); and finance, insurance, and real estate (7.2 percent) (BEA 2002).

The labor force in the ROI increased 17.7 percent from 1990 to 2001, an average of 1.6 percent each year. In comparison, the state labor force increased at a greater rate, a total of 18.4 percent over the same time period. Total employment in the ROI increased at a faster pace than the labor force, a total of 19.7 percent. Unemployment fell from 5.0 percent in 1990 to 3.3 percent in 2001. In comparison, the state-wide average unemployment fell from 6.5 in 1990 to 4.8 in 2001 (BLS 2002a).

Per capita income in the ROI ranged from a high of $40,482 in Los Alamos County to a low of $15,115 in Rio Arriba County in 2001. The average per capita income in the ROI was approximately $27,700, compared to the New Mexico average of $21,931. Per capita income increased by almost 51 percent from 1990 to 2000, compared to a state-wide increase of 46.8 percent (BEA 2002).

### 4.2.8.2 Population and Housing

From 1990 to 2000, the ROI population grew from 151,408 to 188,825, an increase of 24.7 percent. This was a higher rate of growth than the rate for the entire State of New Mexico, which grew by 20.1 percent during the same time period. Santa Fe County had the highest rate of growth at 30.7 percent, while Los Alamos County had the lowest rate of growth at only 1.3 percent (Census 2002).

In 2000, the total number of housing units in the ROI was 83,654 with 75,023 occupied. There were 54,160 owner-occupied housing units and 20,863 occupied rental units. In 2000, the homeowner vacancy rate in the ROI ranged from a high of 1.5 percent in Santa Fe County to a low of 1.1 percent in Los Alamos County, while the rental vacancy rate ranged from 11.3 percent in Los Alamos County to 5.6 percent in Santa Fe County. This is comparable to the state rates of 2.2 percent homeowner vacancy and 11.6 percent rental vacancy. The greatest number of housing units in the ROI is in Santa Fe County with almost 69 percent of the total housing units (Census 2002).

#### 4.2.8.3 Community Services

There are a total of 7 school districts in the ROI serving over 25,000 students. The student-to-teacher ratio in these districts ranges from a high of 16.8 in the Española Municipal District in Rio Arriba County to a low of 11.7 in the Dulce Independent District in Rio Arriba County. The average student-to-teacher ratio in the ROI is 14.5 (NCES 2002).

The ROI is served by 5 hospitals with a capacity of 457 beds. The largest hospital in the ROI is St. Vincent Hospital in Santa Fe. The closest hospital to LANL is the Los Alamos Medical Center (AHA 1995). There are approximately 427 doctors in the ROI, with most of them concentrated in Santa Fe County.

### 4.2.9 Radiation and Hazardous Chemical Environment

#### 4.2.9.1 Radiation Exposure and Risk

Because there are many sources of radiation in the human environment, evaluations of radioactive releases from nuclear facilities must consider all ionizing radiation to which people are routinely exposed.

An individual's radiation exposure in the vicinity of LANL amounts to approximately 425 mrem/yr as shown in Table 4.2.9.1–1 and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products; and nuclear facilities. Doses of radiation are expressed as mrem, rem (1,000 mrem), and person-rem (sum of dose to all individuals in population). All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 2001 are listed in *Environmental Surveillance at Los Alamos During 2001* (LANL 2002b). The doses to the public resulting from these releases are presented in Table 4.2.9.1–2. The offsite maximally exposed individual (MEI) is a hypothetical member of the public who, while not on LANL property, received the greatest dose from LANL operations. The location of the offsite MEI in 2001 was at East Gate along NM 502 entering the east side of Los Alamos County. The radionuclide emissions contributing the majority of the dose to the offsite MEI are those emissions associated with the Los Alamos Neutron Science Center (LANSCE). During LANSCE operations, short-lived positron emitters such as carbon-11, nitrogen-13, and oxygen-15 are released from the stacks and diffuse from the buildings. LANSCE stack emissions were larger in 2001 as a result of changes to the 1 L-target water-cooling system. Therefore, the offsite MEI dose was 1.9 mrem this year compared with 0.64 mrem in 2000. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

**Table 4.2.9.1–1. Sources of Radiation Exposure to Individuals in the LANL Vicinity Unrelated to LANL Operations**

| Source | Radiation Dose (mrem /yr) |
|---|---|
| **Natural Background Radiation** | |
| Total external (cosmic and terrestrial) | 120 |
| Internal terrestrial and global cosmogenic | 40[a] |
| Radon in homes (inhaled) | 200[a] |
| **Other Background Radiation[a]** | |
| Diagnostic x rays and nuclear medicine | 53 |
| Weapons test fallout | less than 1 |
| Air travel | 1 |
| Consumer and industrial products | 10 |
| **Total** | 425 |

[a] An average for the United States.
Source: Derived from data in NCRP 1987.

**Table 4.2.9.1–2. Radiation Doses to the Public from Normal LANL Operations in 2001 (Total Effective Dose Equivalent)**

| Members of the Public | Atmospheric Releases | | Liquid Releases | | Total | |
|---|---|---|---|---|---|---|
| | Standard[a] | Actual | Standard[a] | Actual | Standard[a] | Actual |
| Offsite MEI (mrem) | 10 | 1.9 | 4 | 0 | 100 | 1.9 |
| Population within 80 km (person-rem) | None | 1.6 | None | 0 | None | 1.6 |

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
Source: LANL 2002b.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI of the public due to radiological releases from LANL operations is estimated to be $9.5 \times 10^{-7}$, or 9.5 cancer deaths in a population of 10,000,000. The estimated probability of this offsite MEI dying of cancer at some point in the future from radiation exposure associated with one year of LANL operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

According to the same risk estimator, $8 \times 10^{-4}$ excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL from normal LANL operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2001 from all causes in the population of 277,000 living within 80 km (50 mi) of LANL was 554. This expected number of fatal cancers is much higher than the $8 \times 10^{-4}$ fatal cancers estimated from LANL operations in 2001.

External radiation doses have been measured in areas of TA-55 that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed average doses within TA-55 of about 150 mrem (LANL 2002b).

LANL workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at LANL from operations in 2001 are presented in Table 4.2.9.1–3. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among LANL workers from normal operations in 2001 is 0.045. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

**Table 4.2.9.1–3. Radiation Doses to Workers from Normal LANL Operations in 2001 (Total Effective Dose Equivalent)**

| Occupational Personnel | Standard | Actual |
|---|---|---|
| Average radiation worker dose (mrem) | 5,000[a] | 85 |
| Collective radiation worker dose[b] (person-rem) | None | 112.9 |

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 1,330 workers with measurable doses in 2001.
Source: DOE 2001f.

### 4.2.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to the Occupational Safety and Health Administration (OSHA) and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

During 2001, LANL designed and implemented a new air-monitoring program to provide enhanced nonradiological air monitoring data under normal conditions. The objectives of this program are to:

- Develop the capability for collecting nonradiological air monitoring data.
- Conduct monitoring to develop a database of typical background levels of selected nonradiological species in the communities nearest LANL.
- Measure LANL's potential contribution to nonradiological air pollution in the surrounding communities.

This program samples environmental levels of nonradiological air constituents in Los Alamos County. Constituents monitored include: total suspended particulate matter, $PM_{10}$, particles with diameters of 2.5 micrometers or less ($PM_{2.5}$), volatile organic compounds (VOC), and inorganic elements on particulate matter. In 2001, the VOCs included up to 160 compounds, and the inorganics included up to 15 elements (arsenic, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc) (LANL 2002b). The results of this program indicate that the ambient air quality in and around LANL meets all EPA and DOE standards for protecting the public and workers.

### 4.2.10 Traffic and Transportation

#### 4.2.10.1 Regional Transportation Infrastructure

Northern New Mexico is bisected by Interstate 25 (I-25) in a generally northeast-southwest direction, connecting Santa Fe and Albuquerque. As indicated in Figure 4.2.10.1–1, access to Los Alamos from I-25 follows the Santa Fe bypass (NM 599) to United States Highway (U.S.) 84/285 north to NM 502. From the town of Española to LANL, commuters take NM 30 to NM 502. From the west, commuters take NM 4, with NM 501 providing access to the northern part of the site. The State of New Mexico has designated the route that hazardous and radioactive shipments must take. These shipments must leave the site on East Jemez Road, travel north on NM 4 to NM 502 and back to I-25 as previously described.

#### 4.2.10.2 Local Traffic Conditions

Due to the remoteness of LANL and its location on top of the Pajarito Plateau, the roads in the region have some sharp curves. NM 502 is a winding, rather steep, two-lane highway as it rises up from the canyon floor. In other locations, such as at the interchange with NM 4, NM 502 is a five-lane road. However, overall capacity is limited by the two-lane sections. The other roads in the region are all two-lane roads. Therefore, road capacities in the region are not large.

Most commuter traffic originates from Los Alamos County or areas east of Los Alamos County. Therefore, NM 502 and NM 4 (from White Rock) are heavily influenced by LANL commuters. Only 2 percent of commuters arrive from the west on NM 4. Traffic on area roads is light except during periods influenced by LANL commuters and the noon hour, during which congestion is heavy but shortlived. Average daily traffic conditions on the four access roads to LANL are 28,000 vehicles on NM 502 at the LANL boundary (Diamond Drive across the Los Alamos Canyon Bridge); 8,000 vehicles on NM 4 between White Rock and NM 502 (Pajarito Road); 6,000 vehicles on NM 4 near the western LANL boundary (East Jemez Road); and 1,000 vehicles on NM 501 between NM 4 and East Jemez Road (NM 4/West Jemez Road from the west) (DOE 2002n).


**Figure 4.2.10.1–1. Highways in the Region of LANL**

### 4.2.11 Waste Management

This section describes the DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at LANL and on DOE's capability to manage such waste. LANL manages the following types of waste: transuranic (TRU) waste, including mixed TRU waste; low-level waste (LLW); mixed LLW; hazardous waste; and nonhazardous or sanitary waste. Table 4.2.11–1 provides the routine waste generation rates at LANL. Table 4.2.11–2 summarizes the waste management capabilities at LANL.

**Table 4.2.11–1. Annual Routine Waste Generation from LANL Operations ($m^3$)**

| Waste Type | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Transuranic | 80.8 | 93.8 | 99.1 | 122 | 114 | 63.2 |
| Low-level | 531 | 532 | 566 | 717 | 401 | 376 |
| Mixed | 6.82 | 5.80 | 4.50 | 5.84 | 5.03 | 7.52 |
| Hazardous[a] | 89.0 | 122 | 269 | 32.9 | 21.7 | 46.0 |
| Sanitary[b] | 2,060 | 2,240 | 2,090 | 2,540 | 2,370 | 1,990 |

[a] Includes state-regulated waste. Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at: http://cid.em.doe.gov/). Sanitary waste reported in metric tons.
Source: DOE 2002o.

**Table 4.2.11–2. Waste Management Facilities at LANL**

| Facility Name/ Description | Capacity | Status | Applicable Waste Types | | | | |
|---|---|---|---|---|---|---|---|
| | | | LLW | Mixed LLW | TRU Waste | Hazardous Waste | Nonhazardous Waste |
| **Treatment facility ($m^3$/yr)** | | | | | | | |
| LLW compaction | 76 | Online | X | | | | |
| Sanitary wastewater treatment | 1,060,063 | Online | | | | | X |
| **Storage facility ($m^3$)** | | | | | | | |
| LLW storage | 663 | Online | X | | | | |
| MLLW storage | 583 | Online | | X | | | |
| TRU waste storage | 15,182 | Online | | | X | | |
| Hazardous waste storage | 1,864 | Online | | | | X | |
| **Disposal facility** | | | | | | | |
| TA-54 Area G LLW disposal ($m^3$) | 252,500 | Online | X | | | | |
| Sanitary tile fields ($m^3$/yr) | 567,750 | Online | | | | | X |

Source: DOE 2002k, LANL 2002a.

### 4.2.11.1 Low-Level Radioactive Waste

Solid LLW generated by the LANL's operating divisions is characterized and packaged for disposal at the onsite LLW disposal facility at TA-54, Area G. Waste minimization strategies are intended to reduce the environmental impact associated with LLW operations and waste disposal by reducing the amount of LLW generated and/or by minimizing the volume of LLW that will require storage or disposal onsite (LANL 2001b).

A 1998 analysis of the LLW landfill at TA-54, Area G indicated that at previously planned rates of disposal, the LLW landfill's disposal capacity would be exhausted in a few years. Reduction in LANL's LLW generation has extended this time to about 5 years; however, potentially large volumes of waste from planned construction upgrades and the LANL Environmental Restoration/Decontamination and Decommissioning Program could fill the remaining available landfill rapidly (LANL 2001b).

As part of implementation of the Record of Decision (ROD) (64 FR 50797; September 20, 1999) for the LANL SWEIS (DOE 1999a), DOE will continue disposal of LANL-generated LLW using the existing footprint of the Area G LLW disposal area and will expand disposal capacity into Zones 4 and 6 at Area G. This expansion would cover up to 29 ha (72 ac). Additional sites for LLW disposal at Area G would provide onsite disposal for an additional 50-100 years (LANL 2001b).

#### 4.2.11.2 Mixed Low-Level Waste

Mixed LLW generation at LANL is very small, about 5 cubic meters ($m^3$) (176 cubic feet [$ft^3$]) per year. Most of LANL's routine mixed LLW results from stockpile stewardship and management and from R&D programs. Most of the nonroutine waste generated by off-normal events such as spills is stored in legacy-contaminated areas. Typical LANL mixed LLW items include contaminated lead-shielding bricks, R&D chemicals, spent solution from analytic chemistry operations, mercury cleanup-kit waste from broken fluorescent bulbs and mercury thermometers, circuit boards from electronic equipment removed from a TRU waste radiation area, discarded lead-lined gloveboxes, and some contaminated water removed from sumps.

Typically, mixed LLW is transferred to a satellite storage area after it is generated. Whenever possible, the materials are surveyed to confirm the radiological contamination levels, and if decontamination will eliminate either the radiological or the hazardous component. If decontamination is possible, materials are then decontaminated and removed from the mixed LLW category.

Mixed LLW is managed in accordance with appropriate waste management and Department of Transportation requirements and shipped to TA-54. From TA-54, the mixed LLW is sent to commercial and DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components and macro-encapsulation or incineration). A small fraction of the LANL-generated mixed LLW has no disposal path. Typically, this waste is radiation-contaminated mercury or mercury compounds (LANL 2001b).

#### 4.2.11.3 Transuranic and Alpha Waste

TRU waste at LANL can be classified as either legacy waste or newly generated waste. Legacy waste is that waste generated before September 30, 1998. Newly generated waste is defined as waste generated after September 30, 1998. The newly generated wastes are subdivided further into solid and liquid wastes, as well as routine (operations) and nonroutine (environmental restoration, decontamination and decommissioning [D&D]) wastes.

TRU solid wastes are accumulated, initially assayed, and characterized at the generation site. The waste is packaged for disposal in metal 208-L (55-gal) drums, standard waste boxes, and oversized containers. The 208-L (55-gal) drums are stored in an auxiliary building at TA-55. The standard waste boxes and oversized containers are staged on an asphalt pad behind Plutonium Facility, Building 4 (PF-4) to await shipment to the waste characterization areas at TA-54 or TA-50 (LANL 2001b).

Detailed characterization of TRU waste occurs at TA-54, Building 34, the Radioassay and Nondestructive Testing (RANT) facility; and at TA-50, Building 69, the Waste Compaction, Reduction, and Repackaging Facility (WCRRF). Samples from drums are sent to the Chemistry and Metallurgy Research (CMR) building for characterization in some cases. The TRU waste is stored at TA-54, Area G, until it is certified and shipped to WIPP for disposal. LANL TRU waste shipments to WIPP began on March 25, 1999, and are expected to continue through the foreseeable future (LANL 2001b).

Liquid TRU wastes from the LANL nitric-acid (acidic) and hydrochloric-acid (caustic) aqueous processes are transferred from TA-55 to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) via separate, doubly encased transfer lines for processing and further removal of plutonium by flocculent precipitation. The precipitate is cemented into 208-L (55-gal) drums and transported to TA-54 for storage and ultimate disposal at WIPP as TRU solid waste. In 2000, approximately 11,700 L (3,080 gal) of liquid TRU waste were processed at the TA-50 RLWTF. Of this volume, 76 percent came from the acid waste stream and the remaining 24 percent came from the caustic waste stream. Implementation of the Nitric Acid Recovery System in 2001 is reducing the volume of the acidic liquid TRU waste stream (LANL 2001b).

LANL receives small amounts of TRU waste from other sites. Some of that waste is from nondefense activities and is currently ineligible for disposal at WIPP. Such nondefense TRU waste is stored at LANL pending the development of disposal options.

DOE has developed a plan to accelerate the characterization and disposal of all New Mexico legacy TRU waste (including TRU waste from LANL, Sandia National Laboratory, and Lovelace Respiratory Research Institute). The risk-based plan consists of early characterization and shipping of approximately 2,000 high activity drums that account for about 60 percent of the risk of dispersible radioactivity in storage at TA-54. The proposal would accelerate the Site Treatment Plan milestones and complete the shipment of the legacy TRU waste by 2010 (Ramsey 2002).

#### 4.2.11.4 Hazardous Waste

LANL produces three types of hazardous waste: RCRA waste, the *Toxic Substances Control Act* (TSCA) waste (e.g., polychlorinated biphenyls [PCBs] and asbestos), and state-regulated special waste (as required by the *New Mexico Solid Waste Act* of 1990 and defined by the New Mexico Solid Waste Management Regulations, 20 NMAC 9.1, which includes certain types of solid wastes that have unique handling, transportation, or disposal requirements).

Hazardous waste commonly generated at LANL includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This waste may include equipment, containers, structures, and other items that are intended for disposal and are contaminated with hazardous waste (e.g., compressed gas cylinders). Also included are asbestos waste from the abatement program, wastes from removal of PCB components, contaminated soils, and contaminated wastewaters that cannot be sent to the sanitary wastewater system or the high explosives wastewater treatment plants.

Hazardous waste is initially collected at less-than-90-day storage areas. This waste is then either directly shipped to offsite waste management facilities or sent to TA-54, Area L, from which it will be subsequently shipped to an offsite facility. Most LANL hazardous wastes are disposed of through LANL subcontractors. These companies send the LANL waste to permitted treatment, storage, or treatment storage disposal facilities, recyclers, energy recovery facilities for fuel blending or burning for energy recovery, or other licensed vendors (as in the case of mercury recovery).

#### 4.2.11.5 Sanitary Waste

LANL sanitary wastes are collected in dumpsters, which go to the Materials Recovery Facility. At this facility, items that can be recycled (e.g., cardboard, metal, wood) are segregated from the dumpster waste and sent to recycle. Items that cannot be recycled are sent to the Los Alamos County Landfill (LANL 2001b).

Both LANL and Los Alamos County use the same landfill located within LANL boundaries. The landfill is operated under a special permit by Los Alamos County. Los Alamos has also contracted with Española to receive selected waste from that community. The Los Alamos County Landfill received about 20 million kg (22,000 tons) of solid waste from all sources during the period of July 1995 through June 1996, with LANL contributing about 22 percent, the city of Española contributing about 32 percent, and Los Alamos County contributing about 46 percent of the solid waste. An assessment performed in 1996 estimated the anticipated life of the landfill to be about 18 years (DOE 1999a).

Since the Cerro Grande Fire, the generation of wastes from community and LANL clean-up activities have increased several fold. The Los Alamos County Landfill is scheduled for closure on June 30, 2004. A replacement facility, which would be located offsite, would then be used by LANL for nonhazardous waste disposal. It is currently anticipated that the replacement facility would be located within 160 km (100 mi) of LANL. Both LANL and Los Alamos County would need to transport their wastes to the new facility (DOE 2002k).

#### 4.2.11.6 Wastewater

LANL has three primary sources of wastewater: sanitary liquid wastes, high explosives-contaminated liquid wastes, and radioactive liquid wastes. These wastes are managed in three onsite wastewater treatment facilities: Sanitary Wastewater Systems (SWS) Plant, RLWTF, and the High Explosives Wastewater Treatment Facility (HEWTF).

**Sanitary Liquid Wastes**

Sanitary liquid wastes are delivered by dedicated pipelines to the SWS Plant at TA-46. The plant has a design capacity of 2.27 million L (600,000 gal) per day, and in 2000 processed a maximum of about 950,000 L (250,000 gal) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process (i.e., a digestion process which utilizes living organisms in the presence of oxygen). After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon, adjacent to the power plant, under an NPDES permit and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the SWS Plant as authorized by the existing NPDES permit (DOE 2002k).

In addition to the SWS Plant, there are 36 approved septic systems still in use at facilities located in 16 TAs. Separate from the LANL sanitary waste treatment system, Los Alamos County sanitary waste is processed at two separate facilities. The Bayo Canyon facility processes sewage from the Los Alamos townsite and the DOE Los Alamos Area Office building. This facility has a design capacity of 5.2 million L/day (1.37 million gal/day) of waste and in 1996 was processing approximately 3.4 million L/day (0.9 million gal/day). The White Rock sewage treatment facility processes sewage from the White Rock community and has a design capacity of 3.1 million L (0.82 million gal/day). In 1996, the facility processed about 1.9 million L/day (0.5 million gal/day) (DOE 1999a).

**Radioactive Liquid Wastes**

Liquid LLW is transferred through a system of pipes and by tanker trucks to the RLWTF at TA-50, Building 1. The radioactive components are removed and disposed of as solid LLW at TA-54, Area G. Nonradioactive contaminants (e.g., nitrates, perchlorate) are also removed. The remaining liquid is discharged to a permitted outfall (LANL 2001b).

**High Explosives Contaminated Liquid Wastes**

Wastewater contaminated with high explosives is filtered and recycled to meet current and new regulatory standards for wastewater discharge. To process the high explosives wastewater, solvents are extracted at the processing facility at TA-16. Then, the high explosives wastewater is filtered and recycled using new equipment (located in an adjacent facility). The wastewater will be trucked, as needed, to the HEWTF, which further treats the wastewater through filtering and then discharges the wastewater to a NPDES-permitted outfall. The environmental assessment for the HEWTF provides a detailed description of the high explosives wastewater treatment system upgrade and impacts associated with its installation and use (DOE 1995e).

**Industrial Effluent**

Industrial effluent that does not go through the LANL centralized treatment facilities is discharged to the environment through outfalls. In 1996, DOE decided to eliminate the effluent from several industrial outfalls at LANL to comply with new regulatory requirements and the discharge limitations specified in the NPDES permit.

In 1996, there were 88 outfalls at LANL covered by NPDES Permit NM0028355. The permit contains discharge limitations for each category of outfall based on physical and chemical characteristics of each wastewater type. DOE decided to eliminate industrial effluent from 27 LANL outfalls. That decision includes rerouting industrial effluent from about 14 outfalls to the SWS Plant. Industrial effluent from other outfalls would be eliminated by replacing once-through cooling water systems with recirculation systems, or, in a few instances, making operational changes to eliminate the source of the industrial effluent. After the industrial effluents were discontinued, the affected outfalls were removed from the NPDES Permit. The *Environmental Assessment and Finding of No Significant Impact for Effluent Reduction at LANL* provides a detailed description of the activities undertaken and an evaluation of their consequences (DOE 1996f).

### 4.2.11.7 Pollution Prevention

LANL's Environmental Stewardship Office manages LANL pollution prevention program. This is accomplished by eliminating waste through source reduction or material substitution, by recycling potential waste materials that cannot be minimized or eliminated, and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal.

The total waste (routine waste as well as environmental restoration and D&D waste) generated by LANL was 32,900 $m^3$ (1,161,863 $ft^3$) in fiscal year (FY) 2001, accounting for 5 percent of DOE's overall waste generation. Implementing pollution prevention projects reduced the total amount of waste generated at LANL in 2001 by approximately 4,050 $m^3$ (143,026 $ft^3$). Examples of LANL pollution prevention projects completed in 2001 include: the reduction of hazardous waste by 200 metric tons (220 tons) by identifying a reuse for gamma ray detectors and their housings from a completed study at TA-53; and a reduction of mixed LLW by 14 $m^3$ (494 $ft^3$) by transferring electronic components from LANL's radiological control areas to the Oak Ridge National Recycling Center for recycling (DOE 2002g).

### 4.2.11.8 Waste Management Programmatic Environmental Impact Statement Records of Decision

The *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS) RODs affecting LANL are shown in Table 4.2.11.8–1.

**Table 4.2.11.8–1. Waste Management PEIS Records of Decision Affecting LANL**

| Waste Type | Preferred Action |
|---|---|
| TRU waste | DOE has decided to store and prepare TRU waste onsite prior to disposal at WIPP. LANL would also receive TRU waste from Sandia National Laboratory, which lacks the ability to prepare and store this waste prior to disposal.[a] |
| LLW | DOE has decided to treat LANL's LLW on site and continue onsite disposal.[b] |
| Mixed LLW | DOE has decided to regionalize treatment of mixed LLW at the Hanford Site, INEEL, ORR, and SRS. DOE has decided to ship LANL's mixed LLW to either the Hanford Site or NTS for disposal.[b] |
| Hazardous waste | DOE has decided to continue to use commercial facilities for treatment of most of LANL's non-wastewater hazardous waste.[c] |

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase SEIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

DOE's decisions on the various waste types were announced in a series of RODs based on the Waste Management PEIS (DOE 1997a). The Hazardous Waste ROD (63 FR 41810; August 5, 1998) states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with the Oak Ridge Reservation (ORR) and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The LLW and Mixed LLW ROD (65 FR 10061; February 25, 2000) states that minimal LLW treatment will be performed at all sites, and LLW disposal will continue, to the extent practicable, onsite at Idaho National Engineering and Environmental Laboratory (INEEL), LANL, ORR, and SRS. In addition, Hanford and NTS will be available to all DOE sites for LLW disposal. Mixed LLW will be treated at Hanford, INEEL, ORR, and SRS and disposed of at Hanford and NTS.

The TRU Waste ROD (63 FR 3624; January 23, 1998) states that each DOE site that has or will generate TRU waste will prepare and store its TRU waste onsite, except the Sandia National Laboratory will transfer its TRU waste to LANL. DOE amended this ROD on December 29, 2000 (65 FR 82985), to establish the capability at WIPP to prepare for disposal up to 1,250 $m^3$ (44,144 $ft^3$) of contact-handled TRU waste out of about 7,000 $m^3$ (247,205 $ft^3$) expected to be received annually. DOE also decided to increase the time that waste may be stored aboveground at WIPP up to one year and to expand the storage capacity at WIPP by 25 percent. In a second amendment published on July 25, 2001 (66 FR 38646), DOE decided to transfer approximately 300 $m^3$ (13,843 $ft^3$) of contact-handled TRU waste from the Mound Plant to SRS for storage, characterization, and repackaging prior to disposal at WIPP.